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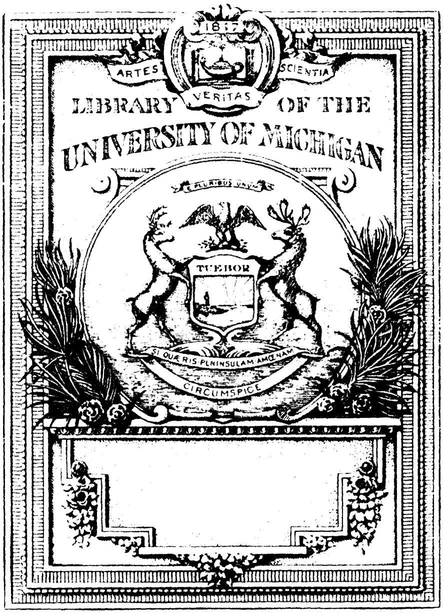

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OCCASIONAL PAPERS

OF THE

BERNICE PAUAHI BISHOP MUSEUM OF POLYNESIAN ETHNOLOGY AND NATURAL HISTORY

VOLUME VIII

HONOLULU, HAWAII
Bishop Museum Press
1923

OCCASIONAL PAPERS

OF THE

BERNICE PAUAHI BISHOP MUSEUM OF POLYNESIAN ETHNOLOGY AND NATURAL HISTORY

Vol. VIII, No. 1

Report of the Director for 1920

HONOLULU, HAWAII
BISHOP MUSEUM PRESS
1921

Bernice P. Bishop Museum

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Otto H. Swezey, M.S.	Consulting Entomologist
Clark Wissler, Ph.D.	Consulting Anthropologist
Robert T. Aitken, B.S.	Research Associate in Ethnology
Forest B. H. Brown, Ph.D.	Botanist
Elizabeth Wuist Brown, Ph.D.	Research Associate in Botany
Edwin H. Bryan, B.S.	Assistant Entomologist
C. Montague Cooke, Jr., Ph.D.	Malacologist
Henry E. Crampton, Ph.D.	Research Associate in Zoölogy
Arthur J. Eames, Ph.D.	Research Associate in Botany
Charles H. Edmondson, Ph.D.	Zoölogist
Kenneth P. Emory, B.S.	Assistant Ethnologist
Charles N. Forbes,[2] B.S.	Botanist
Edward W. Gifford	Research Associate in Ethnology
Edward S. Handy, Ph.D.	Research Associate in Ethnology
Ralph Linton, M.A.	Research Associate in Archaeology
William C. McKern, A.B.	Research Associate in Ethnology
George C. Munro	Associate in Ornithology
Marie C. Neal, A.B.	Assistant Malacologist
John F. G. Stokes	Ethnologist, Curator of Collections
Louis R. Sullivan, M.A.	Research Associate in Anthropology
Gerrit P. Wilder	Associate in Botany
Elizabeth B. Higgins	Librarian and Editor
John W Thompson	Preparator, Acting Curator of Collections
Olga L. Smith, A.B.	Secretary to Director
Helen M. Helvie	Guide to Exhibits
Lahilahi Webb	Guide to Exhibits

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[1] Died June 9, 1920.

[2] Died August 10, 1920.

Report of the Director for 1920

ORGANIZATION OF THE STAFF

By arrangement with Yale University Herbert E. Gregory, who had been serving as Acting Director, was appointed Director for a period of three years beginning October 1, 1920. During the absence of Professor Gregory, the administration of the Museum was in charge of C. Montague Cooke, Jr., for the months of January and February and of Charles H. Edmondson from September 1st to the end of the year.

The Museum has adopted the policy of strengthening its staff by the appointment of distinguished scientists interested in Pacific problems, who are willing to act as members of an informal advisory board. The helpful assistance in this capacity of William H. Dall, Otto H. Swezey, and William Churchill has amply demonstrated the value of such appointments. The Museum is fortunate in the opportunity to add to its list of advisers the names of Clark Wissler, Curator of Anthropology, American Museum of Natural History and member of the Committee on Pacific Investigation of the National Research Council, who has accepted the position of Consulting Ethnologist; and of Elmer D. Merrill, Director of the Philippine Bureau of Science, who as Consulting Botanist will bring to the Museum a wealth of scientific and administrative experience.

On January 1 Forest B. H. Brown (A.B., M.S., University of Michigan; Ph.D., Yale University), was appointed Botanist. Dr. Brown has conducted field surveys in Michigan, Ohio and elsewhere, and his publications show wide knowledge of the anatomy and physiology of plants. He is interested in the origin, distribution and life history of island plants and in the development of methods for research.

On January 1 Marie C. Neal (A.B. Smith College), became Assistant Malacologist. Miss Neal has been Secretary to the Geological Department of Yale University and has had charge of the office and editorial work for the Connecticut Geological and Natural History Survey.

On January 18 by agreement with the American Museum of Natural History, Louis R. Sullivan (A.B., Bates College; A.M., Brown University), was appointed Research Associate in Anthropology. While Assistant in Anthropology at the American Museum (1916–1917), Mr. Sullivan pursued graduate courses in anthropology, paleontology and anatomy at Columbia University and at the College of Physicians and Surgeons. On his release from service as anthropologist in the United States Army (1918–1919), he became Assistant Curator of Anthropology at the American Museum. His twelve published papers include important studies of racial problems.

On February 1 the recently established position of Zoölogist was filled by the appointment of Charles H. Edmondson (Ph.B., M.S., Ph.D., University of Iowa). This appointment has been made possible by an arrangement with the University of Hawaii whereby the University and the Museum combine their resources for the development of zoölogical research.

On February 19 Henry E. Crampton (A.B., Ph.D., Columbia University), Curator of Invertebrate Zoölogy, American Museum of Natural History, was appointed Research Associate in Zoölogy. (See page 17.)

Miss Carolyn Dickerman, Secretary to the Director and Acting Librarian, was released from duty at her request on March 1. Her place was taken by Mary T. Caum, who served until May 19, and by Erla K. Wrenshall, who carried on the work from April 19 until the end of August.

On June 1 Edward S. Handy (A.B., A.M., Ph.D., Harvard) joined the staff as Research Associate in Ethnology to take charge of the Marquesas party of the Bayard Dominick Expedition. As student and instructor at Harvard Dr. Handy has devoted his attention to ethnology with particular reference to Polynesia. His service in the Navy (1917–1919) has added valuable experience.

To coöperate with Dr. Handy, Ralph Linton (A.B., Swarthmore; A.M., University of Pennsylvania), was appointed Research Associate in Archaeology. Following his biological training at

Swarthmore, Mr. Linton studied anthropology at the University of Pennsylvania and at Columbia, and after serving in France during the war returned to Harvard to complete his course. He has taken part in five field expeditions and during 1915–16 served as Ethnologist to the State of Illinois. His published works relate to archaeological research in New Jersey, New Mexico, Colorado and Illinois.

On June 1 Edward W. Gifford was appointed Research Associate in Ethnology. Before assuming the assistant curatorship of the Department of Anthropology, University of California, Mr. Gifford was a member of the staff of the California Academy of Sciences and took part in the Revillagigedo and Galapagos expeditions. He has had large experience in laboratory, museum, and field work in conchology, ornithology, and ethnology. Among his publications are papers on kinship among various Indian tribes.

To collaborate with Mr. Gifford in the Tongan explorations Mr. William C. McKern (A.B. 1917, University of California) was appointed Research Associate in Ethnology. After serving in the Army, July 30, 1917, to March 27, 1919, Mr. McKern became research fellow in anthropology, University of California and instructor in sociology, University of Washington.

Leave of absence was granted to C. Montague Cooke for the purpose of examining collections in mainland institutions and for consultation with students of land shells, particularly at the Philadelphia Academy of Sciences.

On June 18 Mr. Gerrit P. Wilder, an authority on Hawaiian food plants, who for several years has generously assisted in building up collections of the Museum, was appointed Associate in Botany.

On July 1 Robert T. Aitken (A.B., University of California; B.S., Columbia University), was appointed Research Associate in Ethnology. After graduation from the University of California Mr. Aitken was University scholar at Columbia University (1913–15), and Instructor in Anthropology, University of Pennsylvania (1915–18). Following his service as steel erector and foreman in the Hog Island shipyard for the period of the war, he became Assistant in the Department of Anthropology, Milwaukee Public Museum.

On August 1 Kenneth P. Emory (B.S., Dartmouth College), was appointed Assistant Ethnologist. Mr. Emory is familiar with surveying and field methods and his residence in Hawaii has given him an interest in Polynesian problems.

On August 27 Edwin H. Bryan, who had been serving as Assistant Entomologist while completing his course at the University of Hawaii, resigned from the staff to pursue advanced biological studies at Yale University.

The year's leave of absence of Elizabeth Higgins terminated September 1, at which time she assumed the combined responsibilities of librarian and editor.

On October 1 Olga L. Smith (A.B., Smith College), was appointed secretary to the Director.

For the last two months of the year Dorothy Hair has served as clerical assistant to continue the preparation of bibliographical cards for entomology.

On November 18 Arthur J. Eames (A.B., A.M., Ph.D., Harvard University), Professor of Botany, Cornell University, was appointed Research Associate in Botany. Previous studies in the Pacific have made Mr. Eames familiar with the Polynesian flora.

By vote of the Trustees, grades and titles of the Museum staff were redefined. Provision has been made for a Curator of Collections who will have responsible charge of all collections of the Museum. The scientific staff includes full-time professional workers, research associates, assistants, and fellows: consultants and associates are honorary appointees who give generously of their time and thought to the interests of the Museum. Administrative assistants complete the list.

WORK OF THE STAFF

The time of the Director has been given principally to the formulation of plans and the selection of personnel made necessary by the decision of the Trustees to enlarge the scope of the Museum's activities. At the request of the Pan-Pacific Union he assumed responsible charge of the First Pan-Pacific Conference (see page 15), with authority to outline the program, issue invitations, and to perfect a preliminary organization. The Director is serving as Chairman of the Committee on Pacific

Investigations of the National Research Council—a committee which includes Clark Wissler, Curator of Anthropology, American Museum of Natural History, and Consulting Anthropologist, Bishop Museum; T. Wayland Vaughan, Chief Coastal Plains Investigation, United States Geological Survey; William Bowie, Chief, Section of Geodesy, United States Coast and Geodetic Survey; Barton W. Evermann, Director, California Academy of Sciences; John C. Merriam, President, Carnegie Institution of Washington; and William E. Ritter, Director, Scripps Institution for Biological Research, La Jolla, California. To fulfil obligations to Yale University and to develop coöperative agreements with various individuals and institutions on the Atlantic coast, the Director was absent from Honolulu during January and for the period September 1 to December 30.

Early in the year William T. Brigham, Director Emeritus, was occupied in studying plans, previously made by Mr. Stokes, of ruined Hawaiian heiaus. At the First Pan-Pacific Scientific Conference he delivered an address on "The Salient Features of Hawaiian Anthropology." Sailing from Honolulu on September 23, Dr. Brigham made a brief trip to Australia by way of Suva and Auckland, examining collections and renewing personal relations with scientific colleagues, including Mr. Acland Wansey, formerly assistant on the Museum staff.

William Churchill, Consulting Ethnologist, devoted the early months of the year to plans for Polynesian investigations and to consultation with members of the staff engaged in exploration. His wish to establish closer connections with the Museum by transferring his residence from Washington to Honolulu unfortunately remained unfulfilled. By his death, June 9, the Museum has lost the services of a distinguished student of Polynesian languages and customs.

As in previous years O. H. Swezey, Consulting Entomologist, has given his attention to the rapidly increasing collection of insects now in the Museum. In addition to his own contributions he has directed the work of Edwin H. Bryan, part time Assistant in Entomology, and J. August Kusche, voluntary collector, and also that of Miss Dorothy Hair, cataloger.

Before leaving Honolulu, September 29th, to make explorations in the Austral Islands, Robert T. Aitken, Research Associate in Ethnology, assisted in planning a storage system for the Museum collections and made a preliminary survey of the ruins in the Crater of Haleakala.

Forest B. H. Brown, Botanist, spent the first three months of the year in a study of the literature of Pacific Ocean flora and in preparation of papers for the press. The time from April to November was devoted mainly to rearranging the herbarium and cataloging the large collection of Hawaiian wood sections recently presented to the Museum. Two papers were submitted for publication: "Origin of Hawaiian Flora," which forms part of the Proceedings of the First Pan-Pacific Scientific Conference; and "Secondary Xylem of Hawaiian Woods," prepared for the Museum press. On November 20 Mr. Brown sailed for the Marquesas Islands to carry on botanical exploration.

In addition to general studies, Elizabeth Wuist Brown, Research Associate in Botany, completed a paper entited "Apogamy in Osmunda cinnamomea and O. Claytonia" for the Bulletin of the Torrey Botanical Club. Her contribution to the program of the First Pan-Pacific Scientific Conference was a botanical description of seed leis. In November she joined her husband in an expedition to the Marquesas.

Edwin H. Bryan, part-time Assistant in Entomology, made considerable progress in mounting specimens and in preparing a bibliographical catalogue of Hawaiian insects. June 11 to July 8 was given to a profitable collecting trip on the island of Maui.

C. Montague Cooke, Malacologist, gave his attention chiefly to sorting, cleaning, cataloguing, and naming the rapidly accumulating shell material. Time was found for the preparation of a manuscript on "Hawaiian Genera of Pupillidae" to be published in Volume 24 of the Manual of Conchology in collaboration with the editor, Henry A. Pilsbry. During January and February he served as administrative head of the Museum. The last six months of the year were spent in research work and preparation of manuscript at the Academy of Natural Sciences of Philadelphia.

The work of Charles H. Edmondson, Zoölogist, is described on page 23.

During the summer months Kenneth P. Emory, Assistant Ethnologist, was occupied with drafting and miscellaneous work. The months of October, November, and December were given to a survey and preparation of a report of the archaeological remains within the Crater of Haleakala.

The Museum has suffered a serious loss in the death of Charles Noyes Forbes, which occurred August 10, 1920, at his home in Kaimuki, Honolulu.

Mr. Forbes was born at Boylston, Massachusetts, September 24, 1883. Following his elementary training he attended the Ray School, Southboro, Massachusetts (1895-1897), and the High School at National City, California. The years 1904–1908 were spent at the University of California, from which institution he received in 1908 the degree of Bachelor of Science. Soon after graduation Mr. Forbes came to the Museum as Assistant in Botany and was later appointed Curator of Botany, a position which he held at the time of his death. During his twelve years of service on the staff of the Museum Mr. Forbes developed a small miscellaneous collection of plants into an excellent herbarium of Hawaiian flora, a considerable part of which is the product of his own skillful field work. The plans to extend Mr. Forbes' studies to Samoa, Tonga, and other parts of Polynesia were unfortunately made impossible by his death.

In addition to his exacting routine duties as Curator, Mr. Forbes has contributed twelve articles to the Occasional Papers of the Museum. His last work is a paper on "Salient Features of Hawaiian Botany" which forms part of the Proceedings of the First Pan-Pacific Scientific Conference.

A review of Mr. Forbes' activities reveals devotion to high ideals of science, and valuable additions to the knowledge of Polynesian botany, which are remarkable in view of his continuous poor health.

With the exception of a brief stay in Honolulu for consultation and for study of the literature relating to Polynesia, Edward W. Gifford and William C. McKern, Research associates in Ethnology, have been continuously engaged in field study in Samoa and in the Tongan Islands.

Since joining the staff, Edward S. Handy, Research Associate in Ethnology, and Ralph Linton, Research Associate in Archaeology, have been conducting investigations in the Marquesas Islands.

Marie C. Neal, Assistant Malacologist, has devoted her time chiefly to cataloging, rearranging, and recording the land and marine shells belonging to the Museum. During the absence of Mr. Cooke she has had charge of the collections. Miss Neal served as secretary of the Kilauea session of the First Pan-Pacific Scientific Conference.

In addition to routine work, the time of John F. G. Stokes, Curator of Collections, was largely occupied in preparing a report on the ancient "City of Refuge" at Honaunau, Hawaii. Two papers, "Notes on Polynesian Feather Work" and "Notes on Polynesian Migrations and Dispersals," were presented at the First Pan-Pacific Scientific Conference. A paper on "Hawaiian Fish-Poisoning" was submitted for publication. On September 29 Mr. Stokes left Honolulu to conduct explorations in the Austral Islands.

In addition to the exacting duties indicated in his report (page 19) Mr. Sullivan has prepared a paper on Samoan somatology for the Museum press and one on "The Status of Physical Anthropology in Polynesia" for the Proceedings of the First Pan-Pacific Scientific Conference.

Elizabeth B. Higgins, Librarian and Editor, was absent on leave from the beginning of the year until August 15. While on the mainland Miss Higgins made a study of the management and systems of classification of some of the best equipped city and university libraries, and examined the methods used by leading museums and other scientific institutions in connection with the distribution of publications. A study was made also of editorial usage in the Federal scientific bureaus. Since returning to Honolulu Miss Higgins has devoted her time largely to reclassification and cataloging.

The Preparator, John W. Thompson, completed 62 models: fish 11, fruits 38, ethnological implements 5, human heads 7, and a relief map of the island of Oahu. As Acting Curator of Collections from September 29 to the end of the year, much of his time was occupied in preparing for storage and exhibition the unusually large collections of materials received during the year.

The Museum is under obligations to Dr. H. G. Chappel, a prominent research dentist of California, who has generously undertaken a study of the teeth of the human skulls stored in the laboratory. The results of his investigations, which throw light on the racial affinities of the Polynesians, are to be prepared for publication.

J. August Kusche, a man of wide experience in the Pacific, has generously offered to serve the Museum as a volunteer collector during his travels in Melanesia.

The Museum has been pleased to coöperate with Mr. Gerard Fowke of the Federal Bureau of Ethnology, who spent four months in a reconnaissance survey of existing Hawaiian ruins. Mr. Fowke's large experience as an archaeologist enables him to speak with authority, and for this reason his report to the Museum is somewhat discouraging. He recommends detailed mapping and description of all ancient structures, including such features of their surroundings as may have influenced their location. In his opinion none of the ruins in the islands has been surveyed and described with sufficient accuracy for scientific purposes.

Mr. F. W. Colley has been engaged to restore twenty oil paintings in the exhibition halls.

PUBLICATIONS

During the year the following publications were issued:

MEMOIRS VOLUME VI, NUMBER 3, Fornander Collection of Hawaiian Antiquities and Folk-lore, edited by Thomas G. Thrum, 1920, 186 pages.

MEMOIRS VOLUME VI. INDEX, 13 PAGES.

Number 3 of Volume VI of the Memoirs is the concluding part of the Fornander papers, the first installment of which appeared in 1916. It consists essentially of songs and chants and like the preceding numbers the text is in Hawaiian and English.

OCCASIONAL PAPERS VOLUME VII, NUMBER 2. The Languages of the Pacific, by J. MacMillan Brown, 1920, 17 pages.

In this paper Professor Brown emphasizes phonology as the fundamental basis for the classification of languages and concludes "that the main features of the Polynesian tongue go back to the old stone age in Europe."

OCCASIONAL PAPERS VOLUME VII, NUMBER 3. New Hawaiian Plants, by Charles N. Forbes, 1920, 9 pages, 8 plates.

Number 3 describes five new species of *Cyrtandra,* one each of *Hibiscadelphus, Clermontia,* and *Argyroxiphium,* and new varieties of *Viola Kauaiensis* and *Argyroxiphium caligini.*

OCCASIONAL PAPERS VOLUME VII, NUMBER 4. A New Cyanea from Lanai, Hawaii, by Charles N. Forbes and George C. Munroe, 1920, 3 pages, 1 plate.

OCCASIONAL PAPERS, VOLUME VII, NUMBER 5. Notes on Marsilea villosa Kaulf, by Charles N. Forbes. 1920, 5 pages, 2 plates.

Evidence is given in support of the conclusion of W. D. Brackenridge (1854) that *Marsilea villosa* of Hawaii and *Marsilea vestita* of California and Oregon are the same species.

OCCASIONAL PAPERS, VOLUME VII, NUMBER 6. A New Variety of Partulina Horneri, by J. J. and A. Gouveia, 1920, 3 pages, 1 plate.

OCCASIONAL PAPERS VOLUME VII, NUMBER 7. New Species of Sierola with Explanatory Notes, by David T. Fullaway, 1920, 105 pages, 1 plate.

To the list of nine species of Hawaiian *Sierola* known in 1910 Mr. Fullaway has added 171 new Hawaiian and two exotic species. The *Sierola* illustrate the outstanding features of the Hawaiian fauna: remarkable multiplicity of form and numerically large genera.

OCCASIONAL PAPERS VOLUME VII, NUMBER 8. Director's Report for 1919, 1920. 16 pages.

OCCASIONAL PAPERS VOLUME VII, NUMBER 9. Edible Mollusca of the Oregon Coast, by Charles Howard Edmondson, 1920, 25 pages, 6 figures.

In this paper Professor Edmondson discusses the distribution, relationship, and life history of the edible clams and mussels.

The following papers are in the hands of the editor:

A Monographic Study of the Genus Pritchardia, by Odoardo Beccari and Joseph F. Rock.

Fish Poisoning in Hawaii, with Notes on the Custom in Southern Polynesia. by John F. G. Stokes.

Archaeological Survey of Haleakala, by Kenneth P. Emory.

Secondary Xylem of Hawaiian Woods, by Forest B. H. Brown .

Grasses of the Hawaiian Islands, by A. S. Hitchcock.

Contributions to Samoan Somatology, by Louis R. Sullivan, based on studies by Edward W. Gifford and William C. McKern of the Bayard Dominick Expedition.

Requests for publications of the Museum are continually increasing. The total distribution during the year was 3058 including 32 complete sets of Memoirs, 17 of Occasional Papers and 5 sets of Fauna Hawaiiensis. The names of the following institutions have been added to the exchange list: Museo de Historia Natural y Etnografia, Concepcion, Chili; Otago University Museum Library, Dunedin, New Zealand; Institute of Science and Industry, Melbourne, Australia; Cawthron Institute, Nelson, New Zealand; Museo de Etnologia y Antropologia, Santiago de Chili. The complimentary mailing list has also been largely increased.

A contract to print the publications of the Museum has been awarded to the Honolulu Star-Bulletin, Limited, for a two-year period beginning April 1, 1920.

SPECIAL TOPICS

BAYARD DOMINICK EXPEDITION

The two problems of outstanding importance in the study of native races with which the United States is now concerned are the origin of the American Indian and the origin and migration of the Polynesians. A flood of light has been thrown on the first problem by the work of the Bureau of Ethnology, university departments and individuals, and especially by the Jesup North Pacific Expedition of the American Museum of Natural History. The Polynesian problem is still in a reconnaissance stage. Much valuable work has been done, particularly in New Zealand and Hawaii; many papers have been published, but data necessary to the understanding of the history of primitive man in the Pacific area are lacking, and the theories advanced rest on insecure foundations. As stated by the First Pan-Pacific Scientific Conference, "It is evident that fuller knowledge of the history and culture of the Polynesian race is essential to the solution of the ethnographic problems of the Pacific; and also that the opportunities for obtaining information are rapidly disappearing."

An intensive study of Polynesian origin and migration has been made possible through the generosity if Bayard Dominick of New York City, who is deeply interested in primitive races. For the support of the first year's work of the Bayard Dominick Expedition, the sum of $40,000 was given to Yale University and placed by that institution at the disposal of the Bishop Museum.

In consultation with Clark Wissler of The American Museum of Natural History, Roland Dixon of Harvard University, William Churchill of the Carnegie Institution, S. Percy Smith, President of the Polynesian Society, J. MacMillan Brown of Canterbury College, Elsden Best of the Dominion Museum, and others familiar with the status of Pacific anthropology, a two-year program outlined by Bayard Dominick and the Director was adopted by the Trustees of the Museum. In brief the plans are:

Program for 1920–21. Parties consisting of an ethnologist, an archaeologist, and a botanist, with necessary interpreters and assistants are to be stationed at strategic points to make the studies necessary to establish standards of physical form, material culture, traditions, and language of the Polynesians, the results of these studies to be used as a basis for the determination of the significance of changes brought about by overlapping with other races. For this work the existing means of transportation combined with the use of local small boats are fairly satisfactory. The areas selected are Marquesas Islands, Austral Islands, Tongan Islands, and Hawaiian Islands.

Program for 1921–22. A boat with a crew and staff of scientists are to make careful observations in selected localities along the route—Honolulu, Wake, Marshall, Eastern Carolines, Gilbert, Ellice, Samoa, Tonga, Friendly, Cook, and Society Islands—returning to Honolulu via Tongareva, Malden, Christmas, and Fanning Islands. In connection with the previous year's work this cruise should aid in determining through what place or places in the "Polynesian sieve" the ancient migrations came.

For the first year's work of the expedition the Museum has been fortunate in procuring the services of the following men to take charge of the field parties—

The Marquesas party: Edward S. Handy, Ph.D., Ethnologist; Ralph Linton, M.A., Archaeologist, and Forest B. H. Brown, Ph.D., Botanist. Mrs. Edward S. Handy, a student of primitive home economics, and Mrs. Elizabeth Wuist Brown, Ph.D., botanist, are serving as volunteer assistants.

The Tonga party: Edward W. Gifford, Ethnologist; William C. McKern, A.B., Ethnologist; Arthur J. Eames, Botanist. Mrs. Edward W. Gifford, who has had wide experience as a field collector, and Mrs. William C. McKern accompany the party.

The Austral Islands party: John F. G. Stokes, Ethnologist; Robert T. Aitken, B.S., Anthropologist. Mrs. John F. G. Stokes also is with this party.

The Hawaiian party: Louis R. Sullivan, M.S., Anthropologist; Kenneth P. Emory, B.S., Assistant Ethnologist. The services of many efficient volunteers have been gratefully accepted.

An estimate of the value of the work for 1920–21 must await the return of the parties from the field. No reports have been received from the Austral Islands party; fragmentary reports from the Marquesas and Tonga parties indicate success beyond expectation. A preliminary statement of the work of the Hawaiian party is given on page 19.

COÖPERATION WITH THE AMERICAN MUSEUM.

A number of scientific investigations within the scope of an institution concerned with Pacific Ocean problems require funds and personnel which the Bishop Museum cannot furnish. The Museum has, however, in its collections, its associations, and its familiarity with Polynesian problems, assets of high value to other scientific organizations. By combining their resources, institutions interested in the Pacific can undertake work otherwise impracticable. During the present year informal arrangements have been made with the American Museum of Natural History through its President, Henry Fairfield Osborn, its Curator of Anthropology, Clark Wissler, and its Curator of Ornithology, Frank Chapman, which have made possible the pursuit of investigations in two important fields. A systematic study of the Hawaiian race has been in progress since May (see page 19), and field work which is to form the basis of extended research on the bird life of the southern Pacific was begun towards the close of the year by a party from The American Museum.

PAN-PACIFIC SCIENTIFIC CONFERENCE

An appropriation by the Hawaiian Legislature of 1919 prepared the way for calling a Pan-Pacific Commercial and Educational Congress to meet in 1920 or 1921 under the auspices of the Pan-Pacific Union. After full consideration the committee appointed by the Pan-Pacific Union to have charge of the Congress adopted the suggestion of Professor Gregory, that the proposed gathering take the form of a conference designed to formulate the chief scientific problems of the Pacific region and to outline methods for their solution. Under the title "First Pan-Pacific Scientific Conference" the contemplated meeting was held in Honolulu August 2 to 20, 1920, and was attended by 93 delegates from countries bordering the Pacific. Among the officers selected by the Conference are four from the Museum staff: Herbert E. Gregory, Chairman; John F. G. Stokes, Secretary of the Section of Anthropology; Charles N. Forbes, Secretary of the Section of Botany, and Charles H. Edmondson, Secretary of the Section of Zoölogy. Dr. Edmondson, assisted by Kenneth P. Emory and Edwin H. Bryan, took a leading part in administrative matters, and Olga L. Smith and Marie C. Neal served as stenographic reporters. The Trustees gave a public reception to the members of the Conference and their friends.

With the adjournment of the Conference the obligations of the Museum to the Pan-Pacific Union ceased, but the Museum continues to serve the Conference by carrying out its wishes expressed in the following excerpts from the minutes:

> It was voted to request the Bishop Museum to preserve the records of the Conference, to publish and distribute the reports, papers, and proceedings, and to act as representative of the members of the Conference after its adjournment.
>
> It was voted that the delegates from each country represented at the Conference elect one of their number to serve on a committee to arrange for future Conferences. The following were selected to serve with Herbert E. Gregory: E. C. Andrews, Australia; C. M. Fraser, Canada; F. Omori, Japan; Charles Chilton, New Zealand; T. Wayland Vaughan, United States.

Part I of the Proceedings of the Pan-Pacific Scientific Conference, including resolutions and personnel, has been issued, and much of the material for Part II is now in the hands of the editors.

AGREEMENT WITH THE UNIVERSITY OF HAWAII

The Museum has entered into a coöperative agreement with the University of Hawaii "whereby scientific research and the training of investigators may be promoted." The nature of the agreement is indicated by the following extracts:

> There shall be reciprocity in the use of the libraries, laboratories, collections and other facilities for research.
>
> The Bishop Museum will act as depository and curator of systematic collections which fall within the scope of its field of work. The University, on its part, will aid in making these collections.
>
> The Museum will publish scientific papers originating in the University of Hawaii which fall within its field.

Graduate students registered in the University of Hawaii will be allowed to carry on investigations under the guidance of members of the Museum staff.

Advanced students will be allowed the use of the Museum facilities when working under proper direction.

AFFILIATION WITH YALE UNIVERSITY

The administrative organization of most American museums consists of a board of trustees and a director. The trustees are usually laymen unfamiliar with scientific problems and must therefore rely for guidance on the recommendations of the director. After full consideration the Trustees of the Bishop Museum have decided to expand this traditional policy by establishing affiliations with some strong university which includes in its faculty and administrative officers men familiar with plannng and carrying on scientific projects and which sustains close relations with other institutions interested in research.

Under this plan the Director maintains active relations with two institutions and the Trustees have the assurance that plans and methods which involve the activities and the funds of the Museum receive not only their criticism but also that of others. The Director, likewise, has the advantage of personal consultation with a group of men interested in the ethnology and natural history of the Pacific but who are not available as members of the Museum staff.

To inaugurate this plan arrangements for a three-year period have been made with Yale University, whereby the Director of the Museum shall be a member of the University Faculty, and the equipment of the Museum made available for advanced students of the University.

PACIFIC LAND SHELLS

Since 1906 Professor Henry E. Crampton of Columbia University has conducted field and laboratory investigations of the land shells of the Pacific—particularly of the genus *Partula*. Under the auspices of the Carnegie Institution and of The American Museum five expeditions have been made to the Society Islands, Cook Islands, Tonga, and Samoa. Early in the year an opportunity to continue this very important work came to the Bishop Museum through a suggestion of Professor Crampton that the Museum bear the field and travelling expenses of an expedition under his leadership. This proposal was accepted by the Trustees. Professor Crampton's survey is likely to result in collections and publications that will significantly increase existing knowledge of the distribution, ecology, and evolution of Pacific island fauna.

Bishop Museum Fellowships

An agreement with Yale University for the three year period, 1921–24, provides for the establishment of four Bishop Museum fellowships of the value of one thousand dollars each for research in anthropology, botany, zoölogy, geology, and geography. The fellowships are open to men and women who have completed at least one year of graduate study at an institution of high standing; but preference will be given to candidates who have already obtained the degree of Doctor of Philosophy or who have otherwise demonstrated their fitness to undertake original research. The results of all research are to be submitted to the Bishop Museum for publication.

These fellowships make it possible for men of recognized standing to undertake the field work essential for the solution of the problems in which their interest is centered. They also serve to enhance the usefulness of the Museum by making its collections, library, and other equipment available to an increasing number of students.

Improvement in Equipment

In order to increase the efficiency of members of the staff by providing favorable working conditions, a number of changes have been made in the physical equipment of the Museum. The entomological collections have been transferred to a room where adequate light is available; an additional room with suitable cases and apparatus has been provided for the rapidly increasing collections of land shells; a zoölogical laboratory has been organized and equipped, and necessary cases and other apparatus for the classification and study of anthropological material have been installed. The unsatisfactory condition of the library has been relieved by adding about 80 per cent to the space heretofore available for the shelving of books, and by equipping a room for the storage of publications. The rooms heretofore assigned to botany are adequate for a small herbarium, but with the increase in collections and in the number of workers they have become unsatisfactory in extent and location. To remedy this defect, entirely new quarters have been provided, which in roominess, lighting, and equipment are in keeping with the importance of the subject. This reassignment of rooms has made possible the systematic arrangement of material not on exhibition. It is gratifying to note that several rooms remain available for workers who may be added to the staff.

EXTRACTS FROM REPORTS BY MEMBERS OF THE STAFF

ANTHROPOLOGY

As a result of a coöperative agreement between the American Museum of Natural History and the Bernice P. Bishop Museum, Mr. Louis R. Sullivan, Research Associate in Anthropology, has been devoting his energies to somatological studies in Hawaii. He describes his work as follows:

> My first task was to equip an anthropometric laboratory and to repair, recatalog, and provide proper receptacles for the osteological collections. This material was segregated and stored and is now readily accessible for inspection or research.
>
> The work of studying the available osteological material has been carried on intermittently and is now nearly completed, and through the coöperation of George C. Munro, Associate in Ornithology, the collections have been increased.
>
> My principal task has been a study of the living representatives of the Hawaiian race. In Hawaii it has been necessary to study an unusually large proportion of the population, for the great amount of race mixture that has taken place in historic times has made it particularly difficult to decide what were the characteristics of the prehistoric Hawaiians. Although these numerous measurements have necessitated considerable extra work, the results of studying mixed peoples with known family histories will be particularly valuable in arriving at conclusions as to the probable amount and kind of prehistoric mixture that has taken place in this and other Polynesian groups. In all some 2000 Hawaiians and part-Hawaiians have been carefully examined and many of them photographed. Some progress has been made in working up this material for publication.

As Hawaii presents an unique opportunity for the study of race mixture and the effects of environment on the development of man, these studies have been extended to representatives of other races living in Hawaii. This work has been carried on largely in the schools. At the time this report was submitted (April, 1921,) some 8,000 people of races other than Hawaiian have examined and the total number of examinations on all races represented in Hawaii is very close to 11,000.

Besides the work in Hawaii. somatological data sent in from Samoa by Edward W. Gifford and William C. McKern have been put in form for publication.

An unprecedented amount of local interest and coöperation has made it possible to carry out this Hawaiian research work on a large scale. I cannot begin to express my appreciation for the assistance I have received from numerous citizens and local institutions. It is not feasible in this brief report even to mention the names of them all. Nevertheless there are a number who have given an unusual amount of their time and interest toward making this project a success. In the Museum Mr. Stokes has given freely of his time and experience in orientating me in the essentials of Hawaiian customs, language, and culture; Mrs. Webb has coöperated enthusiastically not only during museum hours, but also in the evenings and on Sundays; and Mr. A. F. Judd, President of the Board of Trustees, has given valuable advice as well as assistance in obtaining desirable introductions.

In my work outside of Honolulu I have to thank especially Mr. Thomas C. White of Kona, Hawaii, for invaluable assistance and coöperation. In turn Mr. White and I are both indebted to Rev. Henry P. Judd of the Hawaiian Evangelical Association for letters of introduction which gained for us the support of the ministers of this association. We are also indebted to President Smith and to the elders of the Church of Jesus Christ of Latter-Day Saints for their hearty coöperation. Nor should I fail to mention the valuable assistance given us by Samuel P. Woods, Alfred W. Carter, Edward K. Simmons, Henry K. Lyman, Edward Duvauchelle, Henry Kawewehi, Joseph N. Uahinui, Walter F. Sanborn, Dr. A. Herbert Waterhouse, and Harry Gregson. On Lanai the success of the work was due to the efforts of George C. Munro.

In Honolulu the Hawaiian societies and churches coöperated in every possible way. To the following leaders of these organizations I feel particularly grateful: Mrs. F. M. Swanzy. Princess David Kawananakoa, Miss Lucy Peabody, Rev. Akaiko Akana, Rev. H. K. Poepoe, Rev. S. K. Kamaiopili, High Sheriff W. P. Jarrett, Sheriff Charles H. Rose, and Bandmaster Robert H. Baker.

In the schools Superintendent MacCaughey and his entire staff have given me the most cordial assistance and encouragement. To Mr. Cyril O. Smith of the Royal School I am indebted for permission to begin my work there, to perfect my technique, and to organize my staff. Mr. Smith has also been of the greatest help in giving me introductions and in arranging for meetings with other school principals. Mr. Edgar Wood, Mr. Charles Baldwin, Mr. W. E. Givens, Mrs. Sophie Overend, Mrs. N. L. D. Fraser, Mr. J. A. Wilson, Mr. Isaac M. Cox, Mr. John K. Kaaha, Mr. E. C. Webster, Mr. E. G. Bartlett. Miss Maude Post. Miss Abbie Newton, Mr. A. F. Griffiths, Mr. Levi C. Howland, Mr. Arthur E. Robinson, Miss Mary P. Winne, Miss Sadie Sterrett, and Mr. Chan Ho Min have all helped to make my work pleasant and profitable in their respective schools. In fact everyone upon whom I have called for assistance has responded most generously.

BOTANY

The death of Mr. Forbes and the departure of Mr. Brown for the Marquesas Islands have necessarily somewhat disorganized the botanical work for the year. The formal record of field and laboratory work for 1920 will be included in the report for 1921.

Among the additions to the herbarium are 3000 specimens collected by Charles N. Forbes on the island of Maui; 100 specimens from Hawaii, and 500 specimens from New Zealand collected by Forest B. H. Brown; 183 specimens from Australia and 75 specimens from Prince of Wales Island collected by J. August Kusche; and a valuable suite of 75 specimens of Rubus from Sweden, presented by Mr. C. E. Gufstaffen. For modeling and exhibition 5 varieties of sugar cane were presented by C. Montague Cooke, Jr., and 5 bananas and 24 varieties of taro by Gerrit P. Wilder. The series of wood samples in the Museum has been greatly enriched by donations from the University of Hawaii of 300 specimens of Hawaiian woods transmitted through Mr. Joseph F. Rock and 100 specimens of Philippine woods received from President A. L. Dean. The total additions to the botanical collections so far listed for the year are 3881 herbarium sheets and 450 wood samples.

Additions to the laboratory apparatus and to the library have provided an equipment for botanical work in keeping with the increasing importance of the department.

ENTOMOLOGY

Otto H. Swezey, Consulting Entomologist, who has charge of the collection of insects, submits the following report:

> During the year an accumulation of 3740 insect specimens was made. Of this number 990 were collected in Honolulu and in various ridges and valleys of Oahu, chiefly by Otto H. Swezey and Edwin H. Bryan, a few being obtained by the following: Charles N. Forbes, John W. Thompson, Mrs. Lahilahi Webb, Mr. E. M. Ehrhorn, and Mr. F. X. Williams; 633 were collected at Kaholuamano, Kauai, in April by J. August Kusche; 400 were collected on Kauai in September by Otto H. Swezey; 1717 were collected in various regions of the forests on the windward side of Haleakala, Maui, by Edwin H. Bryan. All the material was pinned up and labelled by Mr. Bryan.

The material collected by Mr. Kusche on Kauai in 1919 and 1920 has been worked up. It includes 125 species, mostly moths, many of which were not previously represented in our cabinets or only by a specimen or two. Nearly a dozen new species are recognized but as yet remain undescribed. With the exception of the collections from Kauai none of this material received during the year has been prepared for installing in the cabinets. It is a considerable addition to the accumulation of native insects now waiting to be worked up.

Seven small lots of insects have been received from Mr. Kusche who has been collecting in the Solomon Islands, Thursday Island, and Prince of Wales Island. These are not yet pinned up. They should show some very interesting forms.

Work on a bibliographical card catalog of Hawaiian insects started by Mr. Bryan has been continued by Miss Dorothy Hair.

MALACOLOGY

C. Montague Cooke, Jr., Malacologist, reports:

During the year. 47,312 shells were entered in the catalog, covering 6,027 numbers. Of these 8,568 specimens (599 catalog numbers), are marine, more than 15,200 (exceeding 500 catalog numbers) are fossil, and the rest fresh material.

The marine shells belong to the Bryan collection, most of the fossil material (15,138 specimens, 506 catalog numbers) was collected by Messrs. F. J. and A. Gouveia on Hawaii, and the rest was collected chiefly by Mr. D. Thaanum and Mr. A. Knudsen on Kauai.

The fresh land-shell material is listed as follows:

Received from	Locality	How received	Number of specimens	Catalog numbers
C. Montague Cocke	Hawaii. Kauai, Lanai, Maui, Molokai, Niihau, Oahu	By gift	6,927	2.676
Richard A. Cooke	Oahu	By gift	2,899	308
George C. Munro	Lanai, Maui	By purchase	2,500	255
Charles N. Forbes	Maui	Collected	2,213	303
W. H. Hoogs, Jr.	Niihau, Oahu	By gift	1,490	31
W. Dimond and H. Waterhouse	Kauai, Maui, Molokai, Oahu	By gift	937	426
M. P. Santos	Oahu	By purchase	709	81
A. Gouveia	Maui, Oahu	One-half by gift for naming	644	133
R. Duncan	Molokai	....	634	40
William Mutch	Molokai, Oahu	By gift	233	80
W. R. Castle, Jr.	Maui, Molokai, Oahu	By gift	114	56
Others			4,000 approx.	1,000 approx.

During the year valuable land-shell material was received from Charles N. Forbes, Edwin H. Bryan, C. Montague Cooke III, and from J. August Kusche (Prince of Wales Island); also marine shells from Mr. George La Guard, Tahiti, and from the estate of Queen Liliuokalani.

On September 16 a collection of land shells made and put in order by the late William D. Wilder was received at the Museum on loan, pending a settlement of Mr. Wilder's estate. The material is stored as four separate collections. The first contains more than 19,300 shells from valleys and ridges of eastern Oahu. They are mostly of the *Bulimella* and *Achatinellastrum* sections of the genus *Achatinella*. There is a box of *Auriculella* and several boxes of *Laminella*. In the second collection are about 20,000 shells from both eastern and western Oahu, over 9,700 belonging to the *Achatinella* section of the genus *Achatinella;* and several thousand shells, many of which are small, belonging to the families Zonitidae, Endodontidae, Helicidae, Amastridae, Tornatellinidae, Succinidae. Helicinidae. In the third collection land shells from Oahu, other islands of the Hawaiian group. and a few from other lands are represented by the families Zonitidae, Endodontidae, Achatinellidae, Amastridae, Tornatellinidae, Succinidae, and Helicinidae—about 7,200 specimens altogether. The fourth collection consists of duplicates which have not been put in order. In the entire Wilder collection are probably about 47,000 specimens.

In the near future the Department of Conchology expects to receive a duplicate set of Tahitian shells (Partula), the gift of Henry E. Crampton.

ZOÖLOGY

From a report by Charles H. Edmondson, Zoölogist, the following has been taken:

For many years zoölogical material has been accumulating in the Museum as a result of the efforts of members of the staff and of systematic collectors. Most of this material was placed in storage until such time as it could be properly cared for. It was the first duty of the zoölogist to make a general survey of the material in the Museum, discard that which was worthless, properly arrange, preserve, and classify that which was of value. The initial work was centered upon the group of Crustacea.

The Crustacea of the Hawaiian Islands are fairly well represented in the Museum as a result of collections made by D. Kuhns, W. A. Bryan, C. Montague Cooke, Jr., C. M. Cooke III, and others, covering a period of many years. In 1900 and 1902, Alvin Seale added many Crustacea from the Marquesas, Tahiti, and Guam, and in 1913 C. Montague Cooke, Jr., greatly increased the collection as a result of an expedition to Palmyra Island. During the past year additions to the list of Oahuan Crustacea in the Museum have been made by C. Montague Cooke, Jr., from Malaekahana. and by Charles H. Edmondson from Malaekahana, Waianae, Koko Head, Kahala, and Waikiki. A total of more than 1000 specimens of Crustacea have been added during the past year, of which 725 were taken from the reefs of Kahala and Waikiki. The entire collection of Crustacea in the Museum has during the year been classified and re-cataloged under a new number series. It is proposed to arrange duplicate series of the more common Crustacea of the Hawaiian Islands for exchange.

In like manner the group Echinodermata, represented by a small amount of stored material in the Museum, has been classified and cataloged. A few specimens of sea urchins, serpent stars, and holothurians have been added to the collection by Charles H. Edmondson, from Waianae, Kahala, and Waikiki.

The classification of the very large collection of Polynesian coral stored in the Museum has barely been commenced. Additions to this group have been made during the year by J. August Kusche from Thursday Island and by Charles H. Edmondson from near Waianae, Oahu. Also a collection of coral from the reef on the leeward side of Oahu was presented to the Museum by Mr. J. C. Bridwell.

During the past year the Zoölogist has given little attention to vertebrates. The representative collection of lizards of the Hawaiian Islands stored in the Museum as well as the remainder of the Reptilia have been cataloged. A few additions to the group of lizards have been made by erchange with the Bureau of Science, Manila, and by collections made by J. August Kusche on Thursday Island.

Through the generosity of the Cooke Estate, a biological laboratory, well equipped for experimental work, has been constructed adjacent to the Aquarium at Waikiki. The laboratory is the property of the University of Hawaii and its Director serves also as zoölogist on the Museum staff. (See page 16.)

In connection with the research work of the biological laboratory an intensive survey of marine organisms of the reef is being carried on; eggs of marine mollusks and crustaceans are being hatched and their early larval stages traced out with more or less success. Work upon the growth of typical reef organisms has begun, and quantitative plankton studies will also be begun as soon as the proper nets are obtained. Under the direction of the zoölogist a graduate student of the University of Hawaii began an investigation of the food of the Hawaiian food fishes in September and will continue the work during 1921.

COLLECTIONS

The description and other items of interest in regard to the exceptionally large amount of exhibition and study material received by the Museum during the year is necessarily incomplete. The Curator of Collections, John F. G. Stokes, who had served as Curator of Polynesian Ethnology until July, found it possible to submit only a fragmentary report before leaving for the field September 29. From the records on file the Acting Curator of Collections, J. W. Thompson, has prepared a memorandum from which the following statements are taken. See also reports on botany, page 21; entomology, page 21; pulmonata, page 22; and zoölogy, page 23. Additional information regarding accessions for the present year will appear in the Annual Report for 1921.

ZOÖLOGICAL MATERIAL

The Museum acknowledges the following gifts: 4 fish from C. M. Cooke III; 1 rare sea urchin from J. S. Emerson; 1 unknown species of marine mollusk from C. M. Kamakawiwoole; collection of fish from J. M. Westgate. From J. W. Thompson have been received 2 ulua, a new or very rare fish from Molokai, and a large specimen, probably a new species of the extremely rare head fish, caught on the south shore of Kauai. Shipments of marine and land shells, insects, crustaceans, and other invertebrates, bird skins, lizards, and snakes from Prince of Wales and Thursday Island have been received from J. August Kusche.

ETHNOLOGICAL MATERIAL

Princess Kawananakoa has given the Museum 5 wooden idols, and the valuable Kekaaniauokalani collection of 23 specimens, chiefly of kahili, has been presented by Mrs. Elizabeth Kekaaniauokalani Pratt, High Chiefess. An Hawaiian meat board and an ancient *ulumaika* are the gifts respectively of Mr. W. R. Castle and Mrs. C. P. Iaukea, and a collection of 150 objects has been received from the administrator of the Queen Liliuokalani Estate.

By purchase the Museum has received the W. H. Cox collection of 341 items, chiefly Melanesian, and the well known collection of J. L. Young. The Young collection, which includes 1080 specimens from Easter, Marquesas, Paumotu, Manihiki, Tahiti, and other Polynesian islands is a noteworthy acquisition. It will be described in the Annual Report for 1921. The ethnological accessions for the year total 1449.

MISCELLANEOUS MATERIAL

The old iron cannon which for many years has been lying on the summit of Punchbowl has been received from the United States Army.

Two crosses of the Legion of Honor presented by Napoleon III to M. Jules Dudoit, first French Consul in Hawaii, were given to the Museum by Captain C. V. Dudoit and M. Jules Dudoit.

The collection of models in the Museum including those made during the present year numbers 1049, and 32 are in process of completion.

LIBRARY

Because of the absence of the Librarian no report on the library was prepared for the year 1919. The following report therefore summarizes the work of the two years 1919 and 1920:

Study of library practice in institutions on the mainland has led me to adopt for the Museum library (1) a simpler method of ordering and accessioning, (2) the Yale charging system—the simplest that I have seen, (3) the Library of Congress scheme of classification. Of the many systems in use the Library of Congress classification seems to me to be the best fitted for our purpose. The change from the old system to the new will require considerable time, but when the arrangement is completed it will, I am sure, be satisfactory. At the end of 1920 the serials were for the most part classified and shelved and a rough classification of the other books had been made, following the Library of Congress scheme.

In the development of the library it will be the future policy to coöperate with the other scientific libraries in Hawaii in order that there may be as little overlapping as possible and that by the combined efforts of all there may be found in Honolulu all the rare old works and the results of recent scientific research that any student of Pacific anthropology or of natural history could reasonably require.

The books received during 1919 and 1920 include several valuable gifts and loans. Special mention should be made of the receipt of 60 scientific volumes from the Library of Hawaii and of a large collection of botanical and ethnological publications given through Dr. N. Yamasaki by the Japanese delegation at the Pan-Pacific Scientific Conference. This Japanese contribution includes 24 volumes and 187 parts. Several of the volumes consist of folio size illustrations of Western Pacific plants with descriptions, and there are a number of volumes and parts from the Journal of Science of the Imperial University in Tokyo. In addition to these gifts ten books were received from the New York Public Library as the result of a tentative exchange arranged at the time of my visit last summer, but the bulk of the exchange will not arrive in time to be counted with this year's accessions. The entire lot contains 78 volumes and 13 pamphlets and consists chiefly of publications of scientific societies and official yearbooks relating to the Pacific.

In October, 1920. an interesting collection of books was placed on loan in this library through the kindness of Mr .Arthur C. Alexander. These volumes from the library of the late Professor William DeWitt Alexander relate chiefly to Polynesia—travels. dictionaries, grammars—and a number of them are written in Oceanic dialects.

For gifts of books. pamphlets, maps, charts, photographs, or manuscripts, we are indebted to the following:

Mr. A. C. Alexander, 2 manuscripts; Argentine Republic, 2 volumes; Australia, Institute of Science and Industry, 1 pamphlet; Australia, Weather Bureau, 1 pamphlet; Mr. W. N. Benson, 2 pamphlets; Mr. A. R. Bloxam, 2 pamphlets; Prince Bonaparte, 1 pamphlet; M. L. J. Bouge, 3 maps; Dr. W. T. Brigham, 2 volumes, 10 pamphlets; Dr. Forest B. H. Brown, 2 author's separates, 1 pamphlet; Dr. Elizabeth Wuist Brown, 7 author's separates; Mr.

J. MacMillan Brown, 1 volume; Canadian Naval Service, 1 volume; Mr. George R. Carter, 2 pamphlets; Mr. T. F. Cheeseman, 1 pamphlet; Mr. L. Cockayne, 1 volume; Dr. C. Montague Cooke, Jr., 57 photographs; Copenhagen, Danish National Association, 1 pamphlet; Mr. C. Cotton. 1 pamphlet; Mr. Reginald A. Daly, 1 volume. 2 separates; Professor W. M. Davis, 2 volumes; Dr. Charles R. Eastman, 1 separate; Dr. Charles H. Edmondson, 3 separates; Mr. Joseph S. Emerson, 3 volumes, 35 parts; Mr. Alexander W. Evans, 5 separates; Mr. John A. Ferguson, 2 volumes; Geophysical Laboratory, Washington, D. C.. 3 pamphlets; Dr. Herbert E. Gregory, 1 volume, 24 pamphlets; Dr. Edward S. Handy, 1 manuscript; Mr. Henry Holmes. 1 volume; Mr. Thomas J. Homer, 1 separate; Iowa State University, 4 pamphlets; Dr. T. A. Jaggar, Jr., 2 pamphlets; Japan, Imperial Earthquake Investigation Committee, 2 pamphlets; Japanese delegation to Pan-Pacific Scientific Conference, 24 volumes, 187 pamphlets; Mr. T. C. Johnston, 1 volume; Mr. A. F. Judd, 6 pamphlets; Rev. Henry P. Judd, 1 volume; Kamehameha Schools, 8 volumes; Library of Congress, 30 pamphlets; Mrs. Jack London, 1 volume; Mr. Robert Lydecker, 1 volume; Mr. Vaughan MacCaughey, 7 pamphlets; Malay States Government. 1 map; Mr. A. Matsumura, 1 pamphlet; Dr. A. G. Mayor. 3 pamphlets; Mexico, La Secretaria de Fomento, 3 pamphlets; New York Zoölogical Society. 1 pamphlet; New Zealand Government, 1 volume; Mr. George E. Nichols, 2 pamphlets; Miss Zelia Nuttal, 6 pamphlets; Mr. W. B. Oliver, 4 pamphlets; Dr. Henry F .Osborn, 1 volume; Pan-Pacific Club, Honolulu, 2 pamphlets; Mr. Sidney Powers, 1 pamphlet; Mr. F. E. Roesler, 6 pamphlets; Mr. Joseph F. Rock, 1 pamphlet; Mr. William E. Safford, 3 pamphlets; Santa Barbara, Museum of Comparative Zoölogy, 4 pamphlets; Mr. E. E. Sherff, 4 pamphlets; Mr. Warren D. Smith, 8 pamphlets; Mr. J. F. G. Stokes, 28 volumes, 3 manuscripts, 19 pamphlets; Mr. J. Stone, 1 map; Mr. T. G. Thrum, 2 volumes, 6 pamphlets; Miss Josephine E. Tilden, 5 volumes; Mr. C. H. Townsend, 1 volume, 5 pamphlets; U. S. Department of Agriculture, 1 volume, 1 pamphlet; U. S. National Museum, 25 pamphlets; University Club of Honolulu, 10 volumes, 9 pamphlets; University of Hawaii, 30 volumes, 6 parts; Dr. H. S. Washington, 3 pamphlets; Washington State University Museum, 1 volume; Mrs. Lahilahi Webb, 1 photograph; Rev. W. D. Westervelt, 1 print; Yale University, 1 volume.

SUMMARY OF ACCESSIONS AND LOANS IN 1919 AND 1920:

	Volumes	Parts and Pamphlets	Photographs	Maps	Engravings
Exchange	157	1337	......	......	......
Purchase	242	298	2	......	4
Gift	120	403	100	6	......
	519	2038	102	6	4
Loan	144	30	......	......	......

EXHIBITION HALLS

The Exhibition Halls continue to be under the efficient supervision of Helen M. Helvie and Lahilahi Webb, who have served as hosts for an unusually large number of visitors. The record of attendance for the year, 29,159, when compared with the average attendance for the previous six years, 14,826, shows an increasing interest in the exhibits. It is gratifying to note that the number of Hawaiian visitors shows an increase of more than one thousand over any previous year. A Sunday attendance of 5442 is the response to the action of the Trustees in furnishing an opportunity for those who are unable to visit the Museum during the working hours of the week. The policy of the Museum to encourage its use by the school children has also borne fruit. Mrs. Helvie reports:

> The attendance throughout the year has been most gratifying, and on Sundays the Museum has been largely patronized by people of all races represented in Hawaii. The great gain in numbers over former years may be attributed partly to the increased number of visitors who came to Honolulu in April to attend the Centennial Celebration of the arrival of the first missionaries, partly also to the visit of several cruisers of the United States Fleet in July. and to the numbers who attended on Sundays.
>
> The attendance of pupils from the various schools has been exceptionally good, and the interest displayed by the children has been most encouraging. In 1918 the number of classes to visit the Museum was 45, representing 1290 pupils; in 1919 there were 46 classes—1625 pupils; and in 1920 the number was 77 classes—3031 pupils, showing a gratifying increase.

OCCASIONAL PAPERS

OF THE

BERNICE PAUAHI BISHOP MUSEUM OF POLYNESIAN ETHNOLOGY AND NATURAL HISTORY

VOL. VIII—No. 2

WITH PLATES I-II

HAWAIIAN DROMIIDAE

BY

CHARLES HOWARD EDMONDSON

HONOLULU, HAWAII
BISHOP MUSEUM PRESS
1922

Hawaiian Dromiidae

BY CHARLES HOWARD EDMONDSON

INTRODUCTION

Among the various special means of protection employed by marine crustaceans one of the most remarkable is the habit of holding over their backs sponges, sea anemones, bivalve mollusk shells, bits of seaweed, or other objects by means of which the host is wholly or partly concealed. The commensal relationship is made possible by the prehensile characteristics of the third and fourth pairs of true walking legs, or of the fourth pair, which are reduced in size, dorsal or subdorsal in position and in many species terminated in chelate or subchelate claws. This strange habit has been observed among certain of the sand crabs of the family Dorippidae, and is of general occurrence in the group Dromiacea, commonly designated as sponge crabs.

Recent investigators are not all in accord as to the taxonomic position of the Dromiacea. Alcock[1] and Borradaile[2] attach the group to the Brachyura, the former giving it the title "Brachyura Primigenia." Benedict[3] and Henderson[4] consider the group as properly within the anomuran division of the decapods. Whether scientists retain the Dromiacea as higher forms of the Anomura (as I am inclined to do), or advance them to the lower division of Brachyura is of small importance. The significant feature of the group is that its members, while showing a considerable degree of specialization in some respects, still retain certain primitive characters indicative of ancestral relationship that clearly mark their line of ascent from the macruran or lower division of the decapods.

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[1] Alcock, A., Catalogue of Indian decapod Crustacea in the collection of the Indian Museum, pt. 1, Brachyura, fasc. 1, pp. 1-80, pls. *A* and 1-7, 1901.

[2] Borradaile, L. A., The sponge-crabs (Dromiacea): Fauna and geography of the Maldive and Laccadive archipelagoes, vol. 2, pt. 1, p. 574, 1903.

[3] Benedict, J. E., The anomuran collection made by the "Fish Hawk" expedition to Porto Rico; U. S. Fish Comm. Bull. vol. 20, pt. 2, pp. 129-148, pls. 3-6, 1900.

[4] Henderson, J. R., Report on the Anomura collected by H. M. S. "Challenger" during the years 1873-76: Voy. of H. M. S. "Challenger," Zool., vol. 27, pp. 1-221, pls. 1-21, 1888.

Referring to the primitive characteristics exhibited by the Dromiacea, Borradaile[5] says: "The most important of these features are: the presence of a pair of vestigial limbs on the first abdominal segment of the female, and often on the sixth in both sexes, the epipodites, which are often found on one or more of the pairs of legs, the number of gills, which is usually large, the more or less square shape of the mouth, the large, usually free, basal joint of the antennal stalk, and the often incomplete orbits." Regarding the presence of vestigial limbs on the sixth segment referred to in the preceding quotation, Borradaile, in a foot-note, p. 574, says: "Bouvier (Bull. Soc. Philomath. Paris, 1896) throws doubt on the correctness of the view which homologizes the structures of this segment in Dromiidae with the last pair of limbs in Macrura." Besides the reduced size and the position of the posterior legs of members of this group, as mentioned above, most of the species are provided with dense coats of hairs or bristles that vary greatly.

At least five families of the group Dromiacea have been recognized by investigators. This report, however, is concerned only with the members of the family Dromiidae known to inhabit the waters about the islands of Hawaii.

The most important characteristics of the family Dromiidae may be summarized as follows: carapace variable as to outline and convexity but with lateral borders usually well defined; sternal grooves of female variable; exopodites confined to the chelipeds, or absent; orbits complete; small lateral plates between the sixth and seventh abdominal segments; both fourth and fifth pairs of legs subdorsal and usually prehensile. Borradaile,[6] in 1903, revised a number of genera of the family Dromiidae, stating, however, that the arrangement was only tentative owing to the lack of information regarding some of the important features of certain species. It must be expected that with a more complete knowledge of forms

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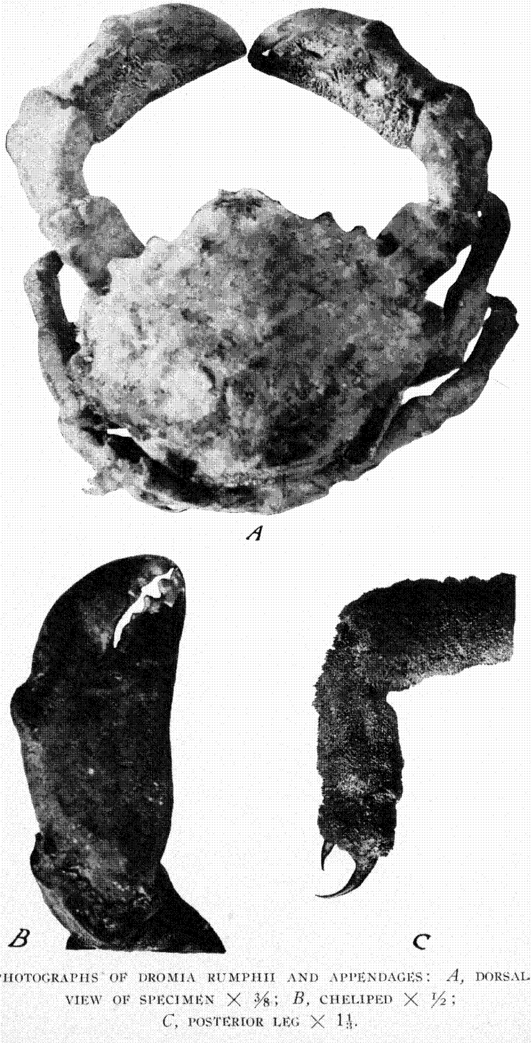
[5] Op. cit.

[6] Borradaile, L. A., On the genera of the Dromiidae: Ann. and Mag. Nat. Hist., ser. 7, vol. 11, pp. 297-303, 1903.



PHOTOGRAPHS OF DROMIA RUMPHII AND APPENDAGES: *A*, DORSAL VIEW OF SPECIMEN × ⅜; *B*, CHELIPED × ½; *C*, POSTERIOR LEG × 1⅓.

already described and the discovery of new ones there will be some shifting of the species and repeated modifications of generic descriptions. Borradaile recognizes twelve genera of the Dromiidae, omitting two other possible ones for lack of information concerning them. His system of genera seems to be the best set forth up to the present time and is the one followed in this report.

This family is widely distributed in the warmer oceans of the world and extends into temperate waters, at least along the shores of Europe and Japan. Its range is from the shallow water of reefs and bays to considerable depths. *Cryptodromia buliffera* Alcock was taken by the "Investigator" near Cinque Island, Andamans, at 490 fathoms.

Of the Dromiidae known to inhabit the waters about the islands of Hawaii, the writer has records of but four species, one of which he has not seen. One specimen that apparently represents a new subspecies is described in the following pages. The four species represent three genera.

DROMIA Fabricius[7]

Dromia rumphii Fabricius. Plate I.

Dromia rumphii Fabricius, Ent. Syst. Suppl., p. 360, 1796.—Alcock, Journ. Asiat. Soc. Bengal, vol. 68, pt. 2, p. 137, 1899, and synonymy.—Lenz, Ergebnisse einer Reise nach dem Pacific (Schauinsland 1896-1897).—Crustaceen: Zoolog. Jahrb. Band 14, Heft 5, p. 450, 1901.—Alcock, Catalogue Indian Decapod Crustacea in the Collection of the Indian Museum, pt. 1, Brachyura, fasc. 1, p. 44, pl. 2, fig. 4, 1901.—Borradaile, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, p. 576, 1903.

Alcock, in the above citations, reports the general distribution of this species to be from Mauritius, Mozambique, and the Red Sea to Japan. Borradaile records the form from Haddumati atoll, Maldive Group, and Lenz reports a single specimen from Honolulu.

There are in the Bishop Museum four specimens of this species, three males and one female, probably from the Hawaiian waters although no data accompanies them. They are all adult forms and are in accord with previous descriptions.

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[7] For a revised definition of the genus see Borradaile, op. cit. p. 298.

Edwards,[8] evidently describing an immature animal, gives the length as 2 inches. Alcock records the largest specimen in the Indian Museum, from Mauritius, as 5¾ inches across the carapace. The largest specimen in the Bishop Museum, a male, measures 183 millimeters between the tips of the teeth immediately behind the branchial grooves. The carapace is 149 and the hand 145 millimeters in length. Plate I, *A*, represents a photograph of a Bishop Museum specimen, *B*, a cheliped of the same, and *C*, a posterior leg.

The species is usually found in comparatively shallow water. In the Indian Ocean it has been taken by the "Investigator" from depths down to 67 fathoms. No information regarding the exact locality or the depth from which the specimens in the Bishop Museum were taken is at hand.

DROMIDIA Stimpson[9]

Dromidia hirsutissima (Lamarck).

Dromia hirsutissima Desmarest, Consid. sur les Crust., p. 137, pl. 18, fig. 1, 1825.—Edwards, Hist. Nat. des Crust., vol 2, p. 176, 1837.—Lamarck, Hist. des An. sans Vert., vol. 5, p. 481, 1838.—Dana, U. S. Expl. Exp., vol. 13, p. 403, 1852.

This species is listed here in consideration of Dana's record from local waters. The writer has seen no specimens of it and has had opportunity to consult but one published description of the species. A. M. Edwards gives the length of the form as about 2 inches and the locality as the Cape of Good Hope. Dana's only comment regarding the species is "Sandwich Islands, five inches in length. Also Cape of Good Hope."

Dromidia unidentata (Ruppell) subsp. **hawaiiensis,** new subspecies. Plate II, *D;* figure 1, *a-j*.

Dromia unidentata Alcock, Journ. Asiat. Soc. Bengal, vol. 68, pt. 2, p. 139, 1899, and synonymy; Catalogue of Indian Decapod Crustacea in the Collection of the Indian Museum, pt. 1, Brachyura, fasc. 1, p. 47, 1901.

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[8] Edwards, A. M., Histoire Naturelle des Crustacés, vol. 2, p. 174, 1837.

[9] For a revised definition of the genus see Borradaile, op. cit. p. 299.

A general description of the subspecies follows:

Carapace longer than broad, strongly convex in both directions; front deeply notched, the two dorsal teeth broad but sharp with a deep furrow between them that extends back on the carapace a little distance; middle tooth of front very small and on a lower level so that it is invisible from above; carapace smooth with regions obliterated except the cardiac, which is faintly outlined; a small oval depression at each antero-lateral angle of the cardiac region, and a very shallow transverse groove representing the posterior boundary of the intra-medial region; orbit with a distinct tooth about the middle of the upper border, representing the inner orbital angle; outer orbital angle prominent; antero-lateral border of the carapace without teeth, curving to the branchial groove; branchial groove well pronounced, extending inward to the cardiac region; thick, chitinized portion of the postero-lateral border of the carapace straight for a little distance behind the branchial groove, there bending abruptly toward the posterior border, postero-lateral corner of carapace rounded out by a thin membrane; cheliped smooth, without epipodite; arm narrow above; wrist with two blunt tubercles on the anterior, outer border; hand rounded above and below; fingers excavated at tips, index with three teeth on the cutting edge, dactylus with three or four very indistinct teeth; last walking leg longer than the preceding one, the propodites of both short and broad, subchelate; a third strong spine on the distal border of the propodite of the last walking leg and two small spines on the outer border of the propodite of the third true walking leg; entire surface, with the exception of the fingers and the tips of the claws, covered with a short, dense coating of hairs; carapace in life, marked by numerous small pearl-white spots.

The color in life is deep orange with the exception of the propodites and claws of the first and second true walking legs, which are pale green. Corneal region of the eye is white, flecked with crimson. The carapace of the specimen in the Bishop Museum was when found completely concealed by a dark-gray sponge.

Greatest length of carapace is 6 millimeters, breadth 5½ millimeters.

Locality: Waikiki reef, Honolulu, in a block of dead coral. Type subspecies, a male in the Bishop Museum (Catalogue No. 571).

This small form, which I have designated as a subspecies, corresponds very closely to the descriptions and figures of the type species *Dromidia unidentata* (Ruppell) but seems to differ from it in certain features. Since only a male has been examined the char-

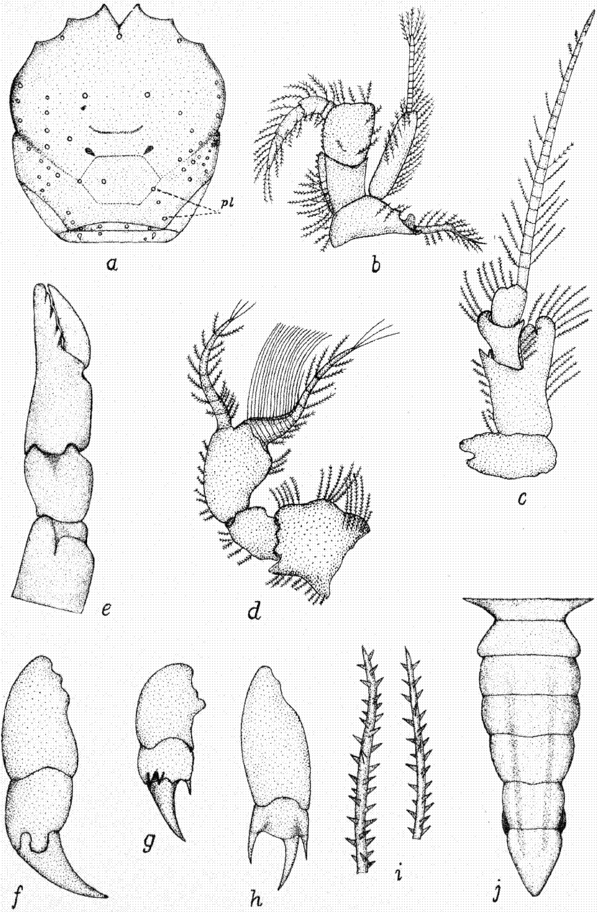

FIGURE 1. Camera lucida drawings of structural features of *Dromidia unidentata hawaiiensis*, new subspecies: *a*, dorsal surface of carapace showing distribution of the pearl-white spots, *pl*, × 7; *b*, outer maxilliped × 10; *c*, antenna × 20; *d*, antennule × 36; *e*, cheliped, with hairs removed, × 13; *f*, second true walking leg, with hairs removed, × 14; *g*, third true walking leg with hairs removed, × 14; *h*, posterior walking leg, with hairs removed, × 15; *i*, hairs typical of carapace and appendages, greatly magnified; *j*, abdomen of male × 28.

acter of the sternal grooves in the female of the Hawaiian form is unknown.

In the Hawaiian subspecies the postero-lateral region of the carapace is composed of two very distinct portions, the thick, chitinized portion, which is straight for a little distance behind the branchial groove, bending very abruptly toward the posterior border, and a thin, apparently non-chitinized membrane, which rounds out the postero-lateral border. The edge of the chitinized portion is parallel with the branchial groove.

The pearl-white spots are distributed on the dorsal surface as well as that of the carapace ventral to the antero-lateral region. Their arrangement and distribution is represented in figure 1, *a*. Some of the spots are very distinct before the surface is denuded of the tomentose covering. The spots number 53 on the dorsal surface of the carapace and on the first abdominal segment, which is seen from above. Ventral to the antero-lateral region is a group of about a dozen similar spots on each side. These spots are not represented by tubercles or bosses but are markings in the carapace or the tissue immediately beneath the carapace. They are very conspicuous in life but fade in alcohol.

The tomentose covering of the crab is short and dense, but longer hairs are found on the lateral borders of the carapace and the legs. The hairs are thickly set with short, flat, triangular branches as indicated by figure 1, *i*.

Almost immediately after the removal of the sponge, which completely concealed the carapace of the specimen described, the crab substituted a fragment of seaweed for its previous covering.

Owing to the small size of the Hawaiian form there is some reason to believe that it may be immature. The largest specimen of *Dromidia unidentata* in the Indian Museum has a carapace 24 millimeters long—according to Alcock, who also announces the distribution of the species as "Red Sea and East coast of Africa. Persian Gulf, Ceylon, Coromandel coast, Andaman Sea, Malay Archipelago."

CRYPTODROMIOPSIS Borradaile[10]

Cryptodromiopsis tridens Borradaile. Plate II, *A-C*.

Cryptodromiopsis tridens Borradaile, Fauna and Geogr. Maldive and Laccadive Archipelagoes, vol. 2, pt. 1. p. 578, pl. 33, figs. 4a and 4b, 1903.

The occurrence of this species in Hawaiian waters is of considerable distributional interest since the only other localities from which it seems to have been reported are Male and Minikoi atolls in the Indian Ocean, where Borradaile's specimens were taken.

Specimens from Waikiki reef, Honolulu, correspond very closely in structural features with the description of the type. It may be noted, however, that in the Hawaiian form the bosses on either side of the cardiac region are more broadly oval than Borradaile's figure would indicate, and that the long axes of the bosses in the Hawaiian specimens are antero-posteriorly placed instead of following the lines of the branchial grooves as figured by Borradaile.

The type specimen is recorded as 6 millimeters in length and 8 millimeters in breadth. The largest of the Hawaiian specimens is 7 millimeters long and 8.5 millimeters broad. There are in the Bishop Museum five specimens, four males and one female, all taken from blocks of dead coral in very shallow water on Waikiki reef. Each crab carried a commensal sponge.

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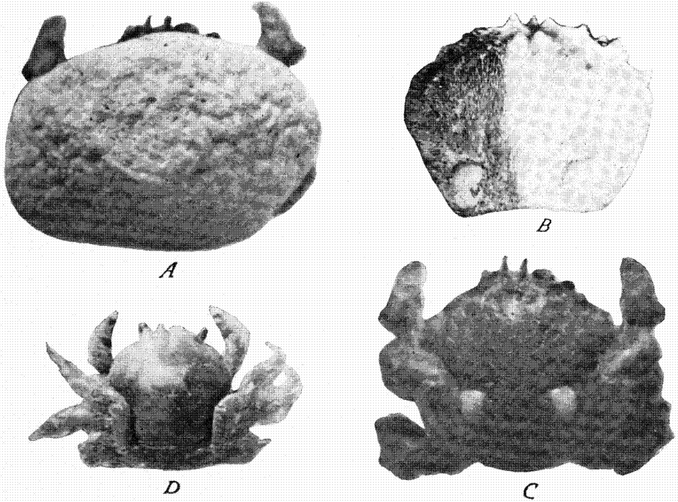
[10] Op. cit. p. 299.



PHOTOGRAPHS OF RARE SPECIES OF HAWAIIAN DROMIIDAE. *A*, CRYPTODROMIOPSIS TRIDENS, CARAPACE CONCEALED BY A COMMENSAL SPONGE, × 5; *B*, CARAPACE PARTLY DENUDED OF ITS HAIRY COVERING, × 5½; *C*, CARAPACE WITH THE SPONGE REMOVED, × 4½; *D*, DROMIDIA UNIDENTATA HAWAIIENSIS, NEW SUBSPECIES, WITH SPONGE REMOVED, × 4.

OCCASIONAL PAPERS

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PROVERBIAL SAYINGS OF THE TONGANS

BY

E. E. V. COLLOCOTT AND JOHN HAVEA

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Proverbial Sayings of the Tongans

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Tubou College, Tonga

INTRODUCTION

PRELIMINARY REMARKS

The Tonga Islands or Friendly Islands consist mainly of low coral islets, the largest, Tonga or Tongatabu, being about 25 miles long from east to west, and rather less than half that distance in width at its broadest part. The group is divided into three well-defined smaller groups: Tongatabu and Eua with a cluster of surrounding islets to the south, the widely scattered Haapai archipelago in the center and Vavau to the north. Far to the northward of Vavau are the outlying islands of Niua Foou and Niua Tobutabu (Keppel's).

The majority of the islands in the Tongan group are low-lying and level, but notable exceptions occur. The surface of the island of Eua which rises in two great tiers to upwards of 1000 feet is marked by splendid rolling uplands and rugged cliffs. The imposing cone of Kao, the highest mountain in the Tonga Islands with an altitude of more than 3000 feet, and its longer and lower, but still lofty, neighbor, Tofua, form the western sentinels of the Haapai group. Farther north is the cone of Late. Vavau with its surrounding islands is hilly and picturesquely wooded. Niua Foou is also high and volcanic; Niua Tobutabu, and the neighboring peak of Tafahi, are each about 2000 feet high.

This widely scattered group is inhabited by a homogenous people speaking one language. It is asserted that formerly there were notable peculiarities in the speech of Eua and Niua Foou, and at the present day words not found in the remainder of the group are in use in Niua Foou. These differences, however, are not very considerable.

The suggestion that a collection of popular sayings should be made came first from the late Rev. Dr. George Brown, the pioneer missionary and explorer, who did much to make known many islands of the Pacific. In the present compilation the collection of "Idiomatical Phrases" in the Tongan Vocabulary of the late Dr. Shirley Baker[1] has been included, as well as many expressions scattered throughout the body of that work. Valuable as Dr. Baker's work is, it is unfortunate that he has printed whole phrases as single words, and without literal translations or explanations. In almost every instance we have been able to separate into their component words and explain these expressions, but there is a small residuum that has not been elucidated by inquiries made among the Tongans of today. Baker's work has been in constant use, and we desire to acknowledge our general indebtedness to it. In the few instances where we have not been able to explain phrases published by him exact quotations have been made.

ORTHOGRAPHY

In orthography we have followed what seemed to be the easiest method for European readers. The nasalized *g*, written as *g* in the various Pacific dialects, we have written as *ng*. The pronunciation of course is like that of *ng* in the English word singer, and not like that in finger.

In Tonga itself animated discussion ranges around the letters *b* and *p*, two symbols which have had an unfortunate history. The Methodist missionaries, who first regularly reduced the language to writing, used only *b*. The French Marists, who followed a few years later, wrote *p*. Subsequently an effort was made by Dr. Baker to combine the two. It is indubitable that there are sounds which strike the ear as an English *b*, and others as an English *p*, and yet others which it is extremely difficult for the ear to distinguish certainly as the one or the other. But the attempt to combine the two symbols has only introduced fresh confusion, as the language does not seem to contain two systematized series of sounds, the one *b* and the other *p*. The Tongan ear finds the greatest difficulty in distinguishing an English *b* from an English *p*.

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[1] Baker, Rev. Shirley W., An English and Tongan vocabulary, also a Tongan and English vocabulary. Auckland, N. Z., 1897.

and does not successfully separate the two sounds until considerable proficiency in English has been attained. An Englishman may pronounce Tongan words with either *b* or *p* without the Tongan noticing the difference, nor does the native pronunciation itself seem to be consistent. In fact the dispute between the two symbols is without meaning for the Tongans except in so far as ecclesiastical considerations affect his preference.

In the present work we have written *p* throughout, to be in agreement with the universal practice in writing other Polynesian languages, feeling that to use *b* would be to over-emphasize a probably non-existent difference between Tongan and kindred dialects.

Another vexed question is involved in the use of *s* and *j*. Speaking broadly, and subject to exceptions, the *s* found, for example, in Samoan, has become *h* in Tongan. There is, however, in modern Tongan a large series of words in which the syllable *si* occurs. As pronounced today this syllable should unquestionably be written with an *s*; but this pronunciation is obviously modern, and in books written about a century ago we find, not *si,* but *tchi* or *chi.* When the language was first reduced to writing this *tch* sound before *i* (compare Samoan *ti*) was written as *j*, and we have retained this symbol. It is interesting to note that although the passage of *tchi* into *si* has been almost completed, one may hear even today, but very rarely, the old pronunciation.

The glottal stop so frequent in Tongan has not been written. Essential as it is that the philologist should take account of it, it has not seemed to call for the emphasis of a separate symbol in writing material which is not intended for philological purposes. It may be remarked in passing that in Polynesian philology too little attention seems to have been paid to this stop. The Tongan ear detects its presence or absence with the same ease and certainty as that with which the English ear detects the difference between *b* and *p*, but the European frequently experiences as great difficulty in separating the stopped from the unstopped vowel as the Tongan does in differentiating between *b* and *p*.

Tongan orthography is in a state of deplorable confusion, but no other matters seem to call for special notice here. Of the remaining divergencies the most notable is that which exists in the writing of dual and plural pronouns, especially when preceded by prepositions, but it happens that these have not entered into our work.

SELECTION OF MATERIAL

In selecting material for inclusion in this collection we have interpreted broadly our title of Proverbial Sayings. We thought it best to commit errors of inclusion rather than of omission. Interesting idioms that could not be regarded strictly as proverbs have been given and a number of modern phrases also have been included. The language is being affected by contact with Europeans, mainly by the inclusion of foreign words in the vocabulary. For example, Fijian and Samoan words were incorporated before the advent of the European, but this enrichment is being accompanied today by a more than corresponding impoverishment in the loss of old words. This process is assisted by the teaching of English in many schools, and by the inevitable desire of the people to learn the language of the dominating culture. Some late innovations, therefore, have found their way into this collection. While our main interest has been in collecting genuine Tongan expressions, yet language is a living entity, and must be regarded in its entirety in any period. A genuine interest moreover attaches to any demonstration that the same psychological factors are at work in this age as in earlier times, and that the instinct of the epigrammatist has not been lost. Similar considerations lend value to the modern efforts of the native genius in poetical composition and story telling, although the later productions have not the historical interest of the earlier. Everything which reveals the working of the mind on the material presented to it has high worth.

Considerable pains have been spent in the effort to make this collection as complete as possible. Although some sources which might have yielded a little more have not been tapped, probably there are very few phrases current today that are not included, and there are many here which have passed out of general use. We feel the diffidence, however, that is inspired by the knowledge that forms of speech frequently become current in separate localities without passing into the general tongue of a whole people. We are fortunate, however, in that the Tongan collaborator has a wider acquaintance than most of his fellows with the different parts of the group.

Doubtless many ancient proverbs have perished. Every generation makes and forgets proverbs. The double process lies patently before our eyes in the Tonga of today. We are familiar with it in our own languages. What we have of the old phrases is probably but a residuum of the expressions that in successive generations have received the currency of common speech and have again dropped into oblivion.

METHOD

In dealing with these proverbs the method adopted has been to give a literal translation of the Tongan phrase, though not always strictly word for word. Although we have followed Tongan rather than English idiom, we have not adhered so closely to Tongan idiom as to render the English ungrammatical or unintelligible. Our aim has been to follow Tongan idiom within the limits of intelligible English. This has been much easier in the case of short phrases like those in this collection than it would have been in translating longer passages. Following this translation is such explanation as is necessary to make clear the meaning and application of the Tongan phrase. In many instances a typical form of application has been indicated, but these uses should be regarded as merely typical, and not exclusive. In other cases nothing has been said about application, but if our efforts to make clear the meanings of the phrases have been successful, the manner of their application will be manifest. Except where special circumstances for the use of expressions have been explicitly mentioned it is safe to assume that what would seem a natural application to a European would seem so also to a Tongan. Where possible we have added stories connected with the expressions. Although doubtless some true derivations are indicated by these tales there are probably some cases where they are the fictions of popular etymology.

In the course of the work we have occasionally suggested English colloquialisms, and even slang, as of kindred meaning to Tongan phrases. Many of the Tongan expressions are of such a nature that they may be appropriately rendered by colloquialisms, and sometimes the nuance of an English vulgarism approaches that of a Tongan phrase. Both alike are the coinage of every-day speech, but there is an important difference in that the Tongan never speaks real slang; he always makes a proper use of true words. Of abusive language there is plenty, but it does not consist of words not current in ordinary speech, but of offensive suggestions and invitations couched in very plain terms. Typical Tongan billingsgate is the request that one eat things that nobody likes to eat, very frequently one's elderly relatives, or excrement. But in all this there is no slang, no employment of unusual or obsolete words.

TONGAN ORATORY

The average of oratorical ability of the Tongans is high. The Tongan seems to know very little of the nervous embarrassment which frequently affects the European when he is unexpectedly summoned to his feet before an assembly. To European taste the delivery of a Tongan oration has little of the polish and artistry that lend grace to the addresses of European masters of speech, but the crudeness lies rather in the manner than in the matter. The Tongan usually speaks to his gathering in a loud voice; frequently he shouts at it. An elderly Tongan clergyman whose felicitous utterances had won for him a deservedly high place among contemporary speakers once boasted to an Englishman of the distance at which he could be heard when he was in his physical prime. The Tongan speaks and shouts as his feelings direct. If he is excited, gestures and voice betray it.

But in spite of some crudities the Tongan is keenly sensible to apposite and graceful language. After all the things which he values in a speaker are those which appeal to a European. He likes a voice that is *malie*, that is, musical and resonant; he asks that words shall be *malie*, that is, that the diction shall be graceful; and he also desires that the words shall *aji*, that is, shall literally be penetrating, shall pointedly and clearly express what it is desired to express. Of these three qualifications, the proportion of Tongan orators who possess the first, the resonant musical voice, is not large to European ears, though probably greater to Tongan ears.

In respect to the remaining qualifications, graceful language and language that hits the mark, the average of Tongan oratory must be rated high. Although in narrative Tongan tends to become more prolix than English and other European languages and has naturally a greater poverty of abstract terms, yet it is on the whole a vigorous and virile language.

The flowers of Tongan speech are perhaps best displayed on ceremonial occasions when orations are delivered before great chiefs, although to European taste these efforts are not so effective as less studied deliverances. Much of the gracefulness of diction is derived from a proper use of chiefly language, consisting of words applied only to chiefs and a skilful selection of terms befitting the august assembly.

In more ordinary speeches an appropriate use of chiefly words adds grace to the oration and phrases such as those in this collection lend not only grace, but are even more valued as belonging to the category of things that drive home one's point. A striking phrase, aptly chosen, makes the desired hit at a single stroke. Such phrases, indeed, are among the most valued adjuncts of oratory. The best Tongan addresses make large use of concrete illustration, and such phrases are frequently admirably fitted to be so employed.

DIVISION OF MATERIAL

We have broken up this collection into conveniently sized blocks according to subject, but the division is rather arbitrary. For most of the expressions the section in which they should be placed has been clear; but some of the phrases might perhaps have been as appropriately assigned to some other division as to the one chosen. We trust that our choice of context will be found on the whole the most useful. A few cross references have been added, but it is obviously impossible to give real continuity to a collection of such diverse material. Within the several groups the arrangement is partly alphabetical, but this arrangement has been freely departed from in order to bring together similar phrases.

The classified table of contents makes apparent the proportions of phrases connected with the several spheres of human activity and shows, as was to be expected, that the sea, seamanship, and fishing furnished many proverbs. Under some of the most important and interesting headings the number of expressions is disappointingly small; but we have had to take the language as we found it.

ACKNOWLEDGMENTS

We desire to express our thanks to those who have assisted us. We owe much to the Rev. R. C. G. Page and to Rev. A. M. Sanders of the Methodist Mission, to many of the Tongan staff of the Mission, and to Rev. C. P. W. Brown, now of New South Wales, but at one time connected with the Methodist Mission in Tonga. Mr. E. W. Gifford and Mr. W. C. McKern, who visited this group from August 1920 to May 1921 as members of the Bayard Dominick Expedition of the Bishop Museum, have not only supplied such phrases as they met with in the course of their investigations, but have also assisted with friendly counsel. Our indebtedness to the Tongan Vocabulary of the late Rev. Dr. Shirley W. Baker, in which is incorporated the earlier Tongan Vocabulary of the late Rev. S. Rabone, has already been mentioned. We have also derived considerable assistance from the Dictionnaire Toga-Français issued by the Marist Mission in Tonga (Paris, 1890), Pratt's Grammar and Dictionary of the Samoan Language (Fourth Edition, Samoa, 1911), Dr. Augustin Krämer's Samoa-Inseln (Stuttgart, 1902 and 1903), and to a less extent from Hazelwood's Fijian Dictionary (second edition, edited by James Calvert, reprinted, London, 1914).

GARDEN AND FARM

1. **A fakaamu mei:** Waking wanting breadfruit.

Apparently mildly abusive of the people of Haapai, who are supposed to be not so well supplied with yams as are the people of Tongatabu, and accordingly are more dependent on the breadfruit and other plants. There is an anchorage in the island of Lifuka in Haapai, very close to where the "Port-au-Prince" was attacked, if not the identical spot, called *Fakaamu-mei*, "Wanting breadfruit," said to owe its name to a chief who used to live in the vicinity, and who in some way became famous for wanting breadfruit.

2. **Api faa toe tuu ai ae teve:** In the well-stocked farm still stands the *teve*.

The *teve* (Amorphophallus) grows wild in the bush. Its root has an acrid taste, but is nevertheless sometimes eaten in periods of scarcity. The true farmer, however well stocked he is with other food plants, will not neglect this unpalatable shrub which will be a stand-by in case of the failure of his other crops.

3. **Fakamotua ke tao ha tua:** Playing the old man to bake a *tua* (a fine kind of yam).

The *tua*, in addition to being a specially good sort of yam, is also one of the hardest varieties to cultivate, and the man who can grow them well is obviously a real farmer. This phrase is a rebuke for a lazy man. Do you expect that sitting down with folded hands like a decrepit ancient is the way to get these fine yams to bake and eat?

4. **Halahala a maala keli:** Misses of well cultivated garden, that is, a yam garden in which the soil is loosened to a good depth and where fine large pieces of seed yam are used.

In such a plantation there may be some holes which miss, but those which do grow well will have such large roots as to compensate for the failures. Applied especially in such sports as boxing, fishing and the like, to one who may fail often to get his blow home, or to catch any fish, but when he does succeed scores so heavily as to redeem his previous failures.

5. **Holi ke utuutu i he maala utu:** To desire to glean in a plantation that is being harvested.

Utuutu is to look for yams in the bush growing wild on the sites of disused gardens. What one finds in this way he is welcome to, but such gleaning must not trespass on gardens which are still being used by their owners.

6. **Huo hoko hoka huo:** Digging together, spades clashing.

If two men are working close together and one strikes his spade against his companion's the accident is likely to prove annoying and lead to a quarrel. The expression, therefore, is an injunction to keep strictly to the line of one's own job without irritating interference with neighboring laborers.

7. **Kaka tuu ofi:** Barren soil near at hand.

An inferior piece of ground conveniently close is more likely to be cultivated than better soil at a distance. The thing of fair quality that is near is better than a superior thing at a distance. A bird in the hand is worth two in the bush.

8. Nae hanga ki fe hoo sipeiti: Where was your spade turned, that is, what has your spade been turned towards?

This is the usual retort to one who begs that which he should have prepared for himself. It refers primarily to the produce of the garden but is used of wealth generally. The word *sipeiti* is not Tongan, but a corruption of the English "spade." Whether, before contact with Europeans, there was a similar expression with the real Tongan word for a spade or digging-stick, we are unable to say.

9. Matenga i vao kaka: Fatigue in barren soil.

The word *vao* signifies a piece of scrub land. The husbandman in preparing for his garden selects a site and clears the brush. This expression is applicable to one who undergoes the labor and fatigue of clearing and planting a piece of land that proves unfertile. It is labor in vain.

10. Ne ongo e fena ka ko Nua: Although she has sprouted yet *Nua*.

An early Tui Tonga sent to the chief Loau for one of his daughters. Instead of asking outright for the girl the Tui Tonga's messenger was instructed to ask Loau for yams. Possibly the messenger himself did not know the purport of his errand but Loau at once understood, probably from previous agreement between himself and the Tui Tonga. Loau had two daughters, the younger not yet of marriageable age, the other named Nua, had recently borne a child. Loau, therefore, still in the language of the yam crop, returned answer to the Tui Tonga that one part of the crop was not yet ripe, and that the other part had already sprouted, using the word *fena*, which means a piece of seed yam which has been planted and commenced to grow. The Tui Tonga replied as above, meaning of course that although Nua had borne a child to someone else yet he still wanted her, for she was a very beautiful woman.

11. Oku fena ae tau kei mula ae tau: The crop is sprouting, the crop is still unripe.

As explained in No. 10, the reference is to the answer of Loau to the Tui Tonga, who sent for one of Loau's daughters. One is over-ripe, and the other is not ripe enough.

12. Paki moe talaha: Pick the remainders too.

In the breadfruit tree all the fruit do not ripen together, and so in plucking the crop the ripe fruit will be taken and the others left to mature. This expression means to strip the tree bare of unripe as well as of ripe fruit.

13. Pala a kahokaho: Rottenness of the *kahokaho*.

The *kahokaho* is a species of yam which grows to a great size and is highly valued. It is a chiefly yam, that is, one especially suitable for presentation to a chief. Even if this prime vegetable has commenced to decay yet it is a *kahokaho,* and something better than the best specimens of many other kinds of yam. Besides what may be called its ethical qualifications due to its rank in the yam hierarchy it is a physically fit tuber, as the remainder of the flesh is not affected by the beginnings of decay.

14. **Taka i fonua mahu:** Going about or living in a fruitful land.

This indicates the general prosperity and comfort of a people when crops are good and none suffers want.

15. **Tatau pe tua mo palai:** The *tua* just like the *palai.*

The *tua* and the *palai* are two sorts of yam, of which the *tua* is much the finer. That which is excellent leaves its proper excellence, becoming the mere equal of things of no account; the chief descending to be no better than the commoner.

16. **Toukai mo hono lohu:** A crop of fruit and its *lohu.*

The crop referred to is the breadfruit. The *lohu* is the forked stick used for picking the breadfruit. When the breadfruit is ripe a man may find that the stick that he has used in a previous season is rotten, and so he has to get another. Probably these sticks are very seldom kept from season to season. The idea is that with the crop one must get a stick for that crop. So of the needs and opportunities of a particular period the men will be found to meet them.

17. **Ufilei fie ufi:** An *ufilei* that wants to be a yam (*ufi*).

Ufi is the general name for all kinds of yam. The *ufi-lei* is a small sweet yam. This indicates one of these small sweet yams that wants to be some other sort of yam. Applied to people who not satisfied with being what they are try to be like someone else.

18. **Utu ta lau:** Harvesting, cutting off leaves.

This is an expression from the yam harvest and indicates primarily a man who digs his yams before they are quite ready, when the tops will have died off. He strikes or cuts off the tops as he digs his crop. The application of such an expression in Tongan is similar to what it would be in English.

PLANTS AND TREES

19. **Akau tuu hala:** Tree standing (in a) road, and so liable to be splashed with mud, struck with knives, or otherwise injured.

This proverb or this explanation is probably modern, as before the introduction of wheeled traffic and of steel implements it would seem that the road-side tree was not exposed to especial injury. However, even under ancient conditions the road-side tree would offer itself first to those in search of timber.

20. **Faifaimalie naa ke pakii ha lau telie:** Go carefully lest thou pluck (break off) a *telie* (*Terminalia catappa,* or *T. litoralis*) leaf.

This phrase is a warning to proceed with care lest a tabu be broken. We do not know its origin.

21. **Faka-hopo taokave:** Making *taokave* jump.

The *taokave* is a kind of coconut which bears small fruits, but carries a large number on the bunch. As the fruits mature the press of so many on the same stalk constantly forces nuts off the bunch. There is a boys' game called *faka-hopo taokave,* which consists in a number of boys lying down side by side all pressing in towards the center. Any boy who gets shoved out of place on to the top of the other must then go to one of the ends. The expression is used proverbially of a number of people giving someone the cold shoulder, crowding out an individual whom they do not want.

22. **Fakatuamelie ki he ete mea oku tau he fuu telie:** Relying confidently on my thing that is hanging in the *telie* tree (*Terminalia catappa* or *T. litoralis*).

There is an old story about one who used to hang food in a tree for another to get. If the food were good and tasty it was hung in a *telie* tree, but if not very appetizing it was put in a *tavahi* tree *(Rhus taitensis?),* The person for whom these supplies were left always anticipated with confidence that what he got from the *telie* would be first-rate, but never expected anything very good from the *tavahi.* Used generally of relying with full confidence on anybody or anything. (See No. 23.)

23. **Fakatuatamaki ki he ete mea oku tau he fuu tavahi:** Without confidence in my thing that is hanging in the *tavahi* tree.

To expect little good from any person or thing. (See No. 22.)

24. **Feji lou-ji:** Breaking off *ji* leaves.

This is recent, and is said to owe its being to the missionary's cow. The leaves of the *ji* (*Cordyline terminalis*) are used for cow feed, and a man who wanted to get into the missionary's good graces would recommend himself by his readiness to get food for the cow. Used generally of ingratiating services.

25. **Fokotuu niu:** Piling up coconuts.

Coconuts are very plentiful in Tonga, and large heaps are gathered. Applied to that which is in great quantity.

26. **Foui ne fai:** The *foui* tree did it.

This is the literal translation following the story told of the origin of the expression. The story is that a man and his wife lived together in a compound fenced all round, but at one spot a *foui* tree growing just outside the boundary leaned over within the compound. The woman often asked her husband to cut this tree down, but he procrastinated until at length a man of irresistible charm climbed up the tree and, thus gaining access to the inside of the compound, successfully paid his addresses to the lady of the house. To her husband's wrath she retorted that his own dilatoriness in cutting down the tree had provided a mode of ingress to the disturber of domestic peace; "It was your *foui* that did it."

The application is exactly parallel to the English phrase that it is So-and-so's own fault. The full expression as given above is not always used, but one frequently says, "It is his own *foui*," that is, "It is his own fault."

27. **Hange ha kainikavea:** Like a parasite.

Kainikavea means a tree which has taken root in the living trunk or branches of another tree finally growing so large as to envelop and conceal its host. The banyan has this habit. Proverbially the phrase is used of a supplanter, one who usurps the rights and privileges of another.

28. **Hange ha lou milemila:** Like a strip of *milemila*.

The *milemila* is a strip of the outer cuticle of the leaves of plants such as the coconut and fan-palm. These strips turn white when dried and bunches of them are used as head ornaments by warriors and dancers. The expression is used of things that are thin and light, and of thin people.

29. **Hange ha lou vahivahi:** Like a *vahivahi* leaf.

The *vahivahi* is a little plant found in considerable quantity on the island of Eua, whose leaves are in constant motion even when the breeze is scarcely perceptible. Used of one who is very obedient, is never still but always running about doing the bidding of others.

30. **Hange ha mahelei to:** Like a strip of sugar cane.

Applied to a thin person, a narrow piece of cloth, and generally to meagre, scanty objects, the comparison being to a thin, sharp-edged, pointed piece of the outer bark of the sugar cane.

31. **Hange ha niu afangia:** Like a nut-tree blown by a hurricane.

Used especially of a man who sways with laughter, like a nut-tree swayed by the wind.

32. **Hange ha niu auulu:** Like a nut tree with the leaves cut off.

This is Tongan banter of a tall person. A coconut tree with the leaves cut off is certainly a very lanky looking object. A touch of poignancy is given to the expression by the fact that the trees so treated are never good bearing varieties, but an unfruitful kind that nobody cares much about.

33. **Hange ha tahii toa:** Like heart of iron-wood (*Casuarina equisetifolia*).

Hard, firm, as we say, "heart of oak."

34. Hange ha tua-niu: Like the midrib of a coconut leaflet.

Used of thin persons or animals, and of small, thin things in general.

35. Hange ha vai fa: Like pandanus water.

The meaning is, scattered in all directions like the water dripping on all sides from the leaves of the pandanus during a shower of rain.

36. Hange ha vao masalu ngaue: Like a field of waving *masalu*.

The *masalu* is a small plant found in quantity on the prairies of the island of Eua. These plants stand close together, and when the wind blows graceful undulations pass over the surface of the field, not unlike the waves that pass through a field of standing wheat. Applies to graceful action. (Compare No. 179.)

37. Hange kuo kai teve: As though had eaten *teve* (*Amorphophallus campanulatus*).

This plant causes stinging and inflammation in the mouth, and may even bring on death. (A. Krämer, Samoa-Inseln, II Band, p. 384.) By proper treatment, however, it may be made fit for food. Used of one who has done something which he rues.

38. Heka he vaa mei popo: Getting on the branch (that is) almost rotten.

This has its obvious application of depending on a weak support.

39. Hoko pe fau moe fau: Joining hibiscus with hibiscus, or hisbiscus coming after hibiscus.

The comparatively tough inner bark of the wild hibiscus (*Hibiscus tiliaceus*) is frequently used as cord, and the expression for hibiscus to be followed by hibiscus is very commonly employed of a strong capable man in any position being followed by another whose qualifications are equally good. It is said that in former times when a Tui Tonga died the body was not buried in the usual way, but that the head and legs were cut off and replaced by the head and legs of another man slain for the purpose. Should this victim be a chief the joining of his head and legs to the trunk of the dead Tui Tonga was said to be a joining of the hibiscus with the hibiscus. There is actual tradition of a Tui Tonga whose body had been disfigured by a rail being supplied with limbs for burial by the devotion of another chief.

40. Hoko ae fau moe polata: Joining banana stem with hibiscus, or banana stem coming after hibiscus.

This is the reverse of No. 39 and indicates a strong capable man being succeeded by one of inferior qualifications. This, too, is referred to the burial of the Tui Tonga. If the man who supplied the legs and head to be interred with the Tui Tonga's trunk were of low rank a piece of banana stem was said to be joined to the hibiscus. A strip of the banana stem of course makes a very poor ligature, being loose fibered and brittle.

41. Hu mata niu: Entering eye of nut.

There are three depressions at the top of the coconut, but only one of these marks a hole. The unskilled person might try to open the nut by piercing one or other of the two false eyes, but the experienced man goes for the right hole. Hence the expression means to get right on the spot, but is used in the bad, or at all events unpopular, sense of kindness confined to one's own immediate relatives or friends; kindness confined to one particular spot.

42. Kai kape fifiji: Eating hot *kape* (*Arum costatum*).

One who has eaten a piece of this root at the pungent stage of its growth will find his mouth so burnt that he will not be likely to join in the conversation and laughter of those about him. This picture of the man sitting silent with his stinging mouth is used of one who, ashamed of a wrong done by him, or for some such reason, sits taciturn in the company of others.

43. Koe vaavaa he koe tagata: Branchy, for 'tis man.

Man, with the wide and numerous ramifications of his relationships, is the most branchy of all things. "Do you call so-and-so a many branched thing? Why, it is nothing compared to man."

44. Malakia a moojipo: The *moojipo* trodden down.

This plant is frequently found in the road-ways, but lives on in spite of being walked upon. So the *moojipo* has passed into a proverb of that which bears up stoutly against ill-treatment and adversity; comes up smiling after every blow.

45. Mamalu a mohuku: Overshadowing of grass.

One is overshadowed by forest trees, and this means literally one who undertakes to make a clearing on land where apparently large trees are standing, and finds that the "trees" are but weak and easily cut plants, "mere grass." So of any task seemingly formidable which, when undertaken, proves easy.

46. Motu lou-tou: Broken *tou* leaf.

The leaf of the *tou* (*Cordia aspera*) is very brittle; a slight pull snaps the leaf completely asunder. So used of that which is broken right across, completely severed.

47. Nonofo ae makahunu moe niu motuu: The *makahuna* (hard volcanic rock) living with the ripe coconut.

These rocks were used for making the stone adzes and were handy for splitting open a coconut, and breaking it up if necessary. The phrase, therefore, indicates the coconut living with that which destroys it. Used of one who is in close contact with that which is his undoing. (Compare No. 243.)

48. Potopoto a niu mui: Wisdom of a young nut tree.

A young tree will sometimes bear a crop as though it were clever at that game, but will pass fruitless through another season. So children will at times behave with all the discretion of adults, but such conduct cannot be expected to be the permanent characteristic of the young.

49. Tautefua a niu motuu: A ripe nut hanging by itself.

There is only one nut on the stalk, but that one is perfect and ripe. A thing of which there are very few, and those few are of fine quality. A man who stands alone, but who is exceedingly capable.

50. To lou oji: Leaf fallen finished, that is, all the leaves fallen.

This is not a familiar form of expression in most parts of the Tongan group, in fact it is ungrammatical; it may have originated in Niua Foou where it seems that such a form is permissible. The phrase is not known, or at least not generally known in Tongatabu. Baker gives, "destitute"; poverty, or rather the poor, being represented as a tree denuded of leaves.

51. Tupu lautolo: Growing (like) *lautolo.*

The *lautolo* is a fast-growing, strong-creeping plant. To grow like this plant is to grow quickly and strongly.

52. Tuutuu kau tala: Stand about I'll tell.

Used for one who makes slighting or offensive remarks about another who, unknown to the speaker, is near by and listening. There is a plantain called the *tuutuu-kau-tala.* Both the name of the plant and the meaning of the expression are connected with the legendary hero Muni, who was cast away at sea at, or before, birth and washed ashore on the island of Lofanga in Haapai. He was found and adopted by a childless couple of Lofanga, but as he grew to manhood his adoptive parents became anxious to get rid of him. Returning home one evening Muni overheard from just outside the house his supposed parents talking about him inside the house. He leaned against a plantain, of the sort now called *tuutuu-kau-tala,* and heard what they had to say. There is a couplet referring to this incident:

Hau ai o tuu kau talai	Come and stand while I abuse
Aeni ne ui ai he hopa ni.	You after whom was named this plantain.

53. Ulu akaua: Overshadowed with trees.

A tree that is dwarfed, unable to reach its full stature and vigor, by reason of a crowd of other trees standing close about it. Used of a warrior who is overcome by the number of foes that press together upon him. Generally of one who, no matter how great his spirit and skill, is overwhelmed by the multitude of difficulties that confront him.

FOOD

PREPARATION

54. **Fengutu a fei-umu ota:** To defend badly cooked (insufficiently cooked) food.

To defend one's badly done work against the criticisms of others, as the man who has prepared and served underdone food may persist, in spite of all that others urge, in declaring that his feast is done to a turn.

55. **Fifi ika maka:** Wrapping rock fish in leaves.

Rock fish are those of fine quality. In cooking fish are frequently wrapped up in a sheath of plaited coconut leaves. The object of this is to keep the fish intact, and is a method employed specially in cooking fish of good quality. A "rock" fish is worth the trouble of plaiting the leaflets round it. Taking pains over a thing that is worth the care. (See No. 203.)

56. **Fifi ika vale:** Wrapping up a fish of no account.

This is the reverse of No. 55. Taking great pains over what is not worth the trouble.

57. **Hange ha feiumu uha:** Like cooking in the rain.

The preparation of food which is carried out in the open, or with the protection only of very inadequate shelters, is rendered difficult by rain; the food is liable not to be as well cooked in wet as in fine weather. This phrase is a rebuke to those who have performed badly a piece of work, although the conditions under which they labored were favorable.

58. **Hange ha fokifokihi tunu:** Like the turning of food baked (in the embers).

Food cooked in this way must not be left alone, but constantly turned. Use of a thing that is in constant requisition.

59. **Hiki lepo:** Moving the *lepo* (leaves with which the earth oven is covered on the outside).

It is used of taking advantage of the temporary absence of anyone to usurp that which belongs to him, "to jump his claim". It is said that the expression originated in one of the voyages of the great canoe called the *Lomipeau,* which is asserted to have brought in one trip from Uvea to Tonga the stones for many of the great sepulchral vaults of the highest chiefs. Seagoing canoes used to be equipped with a *talafu,* a large wooden bowl filled with earth in which ovens were made to cook the food. The *Lomipeau* had an immense *talafu* commensurate with her own huge size, so large that a number of ovens could be dug in it at the one time. It is the practice when the food is taken out of the oven to put aside the leaves with which it was covered, and not mix the leaves belonging to various ovens.

On board the *Lomipeau*, however, was a man named Lasukau who disregarded this rule and moved things round at his pleasure; but no one dared to remonstrate with him because of his personal strength and prowess. For one to place his *lepo* at the side of an oven is to mark that oven as his; for another to move this *lepo* is to disregard the claims of the first man.

60. Hina e toumohomoho: The plantain leaves (*toumohomoho*) are white.

Plantain and banana leaves are used for covering up food in the native oven. When the food is taken up these leaves are called *toumohomoho* and are used to line the baskets in which the food is taken to the house where it will be eaten. These leaves are then cast aside as of no further use. At first they are green, but as they fade their color becomes whitish. If one sees such leaves lying about a house their color is an indication of how long they have been there, so that to say that the leaves are white means that it is a long time since there has been a feast.

61. Kailu fa he tuunga u: To rummage for scraps in the middle of the oven.

This is used of one whose aims are humble but who meets with an unexpected stroke of luck. Just as the man who, searching for remains in places where food has been cooked or eaten, suddenly comes upon unanticipated plenty, here denoted by the middle and lowest part of the oven where the food is most in quantity and best in quality. *Tuunga u,* translated the middle of the oven, means literally the standing-place of the *u*, the stick with which the hot stones are arranged in the earth oven. This stick is used to arrange the stones up the sides of the hole, beginning at the bottom, so that the standing-place from which the stick begins its operations is the lowest and midmost part of the oven.

62. Kina umu tala ki tahi: Depending on the sea for the meat part of a meal.

Looking to an uncertain source of supply; trusting to a capricious support. So many are the hazards of the sea that there is a very good chance of a late dinner if the joints cannot be found ashore.

63. Kuma jii vela hono iku: Little rat, his tail burnt.

Formerly the native rat, a vegetable feeder, was used for human food. The rat at best is but a small animal, and therefore when he is being cooked care should be taken not to burn his tail off. Being served with tail complete makes the most of what size he is. This expression, an expostulation against burning off the tail of the rat, has passed into a proverb for conserving as carefully as possible all there is of any small object.

64. **Namu ma ka nae ilo ahoa:** Smelling of bread but known by daylight.

The word translated "bread" indicates the fermented paste of the breadfruit and other plants. The fruits were buried in pits and kept for long periods. This fermented paste made up in little balls and cooked, is a nourishing and tasty food. Most strangers, however, are debarred from sampling it by the initial difficulty of overcoming their repugnance to this dainty's extremely gamey perfume, which is as objectionable to the European as some cheeses are to the Tongan. The expression originates in the story of the handsome man *(manaia)*, Vainuku of Eua. A certain Female Tui Tonga, went to Eua to see Vainuku, and on landing on the island sent one of her women to procure fire. In spite of his attractiveness Vainuku liked making up and cooking "bread," and the woman found him in the cookhouse engaged in preparing food for the recently arrived visitors. The woman pulled off Vainuku's turban, and seeing him with head uncovered knew who he was, for it was his hair that was his chief beauty. When night came Vainuku went to court the lady visitors, but they all cried out in disgust at the man smelling of "bread," until he came to the woman who had seen him in the cookhouse; she, having seen him by daylight, knew who he was.

65. **Nofo e fononga kae ui moa:** The visitors having no share, but calling fowls.

This indicates a man who calls the fowls, not to entertain his guests as he should, but for some other purpose.

66. **Ota fuifui vai:** Raw fish rinsed with (fresh) water.

Certain sorts of fish are often cut up and eaten raw. The flavor of such fish is most appreciated when they are rinsed with sea-water; they are held to be spoiled if fresh water is employed. This is spoiling a good thing by bad handling, and is applied to one who seeing something he likes, for example, an article or piece of work, tries to make one of the same sort for himself, but bungles it. He spoils a good pattern by his unskillfulness.

67. **Ota tae fuifui:** Raw fish not rinsed.

Raw fish is usually rinsed with sea-water before being eaten. This is sed of a thing not properly done.

68. **Tae ngali vai:** Unfit (for) water, or perhaps unworthy (of) water.

This expression is used of one who has a good reputation and does something unworthy of himself. Literally this expression seems to refer to the eating of raw fish, as No. 67, and to the undesirability of preparing the fish with fresh water. A good fish spoiled by the wrong sort of water; and so a good person spoiled by the wrong sort of behavior.

69. Paki ua uli taki taha vau: Break in two—dirty. Each one scrape.

Refers directly to food such as the yam which has been baked in the embers. Ordinarily the yam, for instance, when taken from the fire would first be scraped clean and then divided among those who are to eat it. This indicates that there must be haste. The yam taken from the fire is to be divided while the charred outside skin is still on, and each one will clean his piece for himself. One of the commonest motives urging to such haste would seem to be the apprehension that an unwelcome visitor will soon be coming to share in the meal. Generally of that which is to be done quickly.

70. Poto hono fijifiji kae vale hono fokifokihi: Skilled at its flipping but unskilled at its turning.

The Tongans flip cooking food with the nail of the fore-finger to test whether it is done or not. Food being cooked in the embers must be turned from time to time. The phrase indicates a man who does none of the work, is not willing to give the food a turn now and again, but is to the fore when it comes to finding out whether it is done or not. Obvious application to a lazy, greedy person.

71. Talia a umu kape: Waiting for a meal of *kape* (*Arum costatum*).

At certain stages of its growth the *kape* is too pungent to be eaten. Hungry men, therefore, may wait for a meal of this root to be cooked only to find after all that they cannot eat it. So the expression is used of disappointed expectation.

72. Teka a ma momoko: Chucking cold *ma* about.

Ma, applied now to European bread, is the fermented fruit of certain plants, most commonly of the breadfruit, prepared by burying it in pits. This method of treatment, which is falling into almost complete disuse, was a very common and successful way of preserving a supply of food. Not only was the uncooked food thus kept for an indefinite length of time, but when cooked it remained good for a long period. One could throw it about anyhow and it still turned up good when wanted again. So of anything which, in spite of hard usage, is still good when wanted.

73. Toki kovi a niu lelei: Good nut is just bad.

Coconut is much used and highly esteemed in Tongan cookery. An article of food which cannot be rendered palatable by coconut must be very bad indeed. The upshot of cooking such a hopelessly unpalatable article with nut is that so much good coconut is merely wasted. Generally of that which is so extremely bad that contact with what is good cannot improve it, but the whole lot is wasted and spoiled.

A story connected with this phrase is that the notorious cannibal Kaifakaau, who was alive at the time of the introduction of Christianity, once tried the experiment of cooking the genital organs of a woman with coconut, but found that he had produced a most unsavory dish and had to throw it all away. He had merely wasted so much good coconut.

74. Ua ji ua pooi: Eating *ji* eating *pooi.*

The *pooi* is a preparation of food, which before the introduction of sugar used to be sweetened with the root of the *ji (Cordyline terminalis).* If one ate up the *ji* beforehand he would have to go without the *pooi.* You cannot eat your cake and have it.

75. Umu toona e he vale: Food cooked by the fool.

Good food that has been spoiled by a bad cook; anything good that has been spoiled by bad treatment.

EATING AND DRINKING

76. Aho kai fonu: Day on which turtle is eaten.

The turtle is a luxury, hence day of treat. It is said that this expression originated with a love adventure of the handsome Lepuha, who lived at Leimatua in Vavau. This good-looking and amorous gentleman came in his wanderings to the house of a woman who lived at the back part of the island, and whose face was disfigured by ulceration. Lepuha had intercourse with the unfortunate woman, who said to him as he was about to depart, "This is a day on which turtle has been eaten." Lepuha ungallantly replied, "*Mavae lua,*" that is, "Going away and vomiting," implying the disgust which he felt at having cohabited with so grievously disfigured a woman. This phrase, *Mavae lua,* is used proverbially for the after disgust one may feel at something he has done.

77. Mavae lua: Separating (and) vomiting. (See No. 76.)

78. Fakahali a vale: Making slip of foolish, that is, the foolish person's way of making food slip down.

Fakahali, making slide, means moderate eating, but the moderation of a foolish person, or of the improvident young, is to eat to repletion without a thought for the future or for anyone who may go hungry just beside him. Applied to eating the expression means to attend only to one's own appetite without regard for others or for the future. Used generally of improvident, foolish conduct, as of a man who is not a sailor going out by himself in a boat or of one who is not a carpenter undertaking to build a house.

79. Fakaua mea melie: Hungry for sweet things.

Baker renders: "To wish to eat sweet or superior food only." It might be used of one who desires only the good things of life.

80. Fakauloula kai: Doing a dance with the food.

A man who is distinguishing himself by fine trencher work, blissfully unaware that his performance is not giving as much satisfaction to his hosts or co-diners as to himself, may be called to his bearings by being asked not to do a dance with the food. An explanation has been offered to the effect that as the onlookers derive pleasure from the dance, so the greedy man behaves as though the spectators derived satisfaction from his exhibition. It may, however, be nothing more than a reference to the nimble movements that the food is being made to execute.

81. Fangafanga uu tau he tae: Preparing to eat, getting to rubbish.

Disappointed expectations, as of one who anticipates food, but finds that there is nothing but rubbish (literally dung) to eat.

82. Fie uo kae kaipo: Wanting friends (literally crowd) but selfish.

This is primarily applicable to the chiefs, about whom the people were wont to gather. A chief who treated his people kindly and fed them well would find many happy to live with him. A chief who selfishly ate the best of everything himself was not taking the right measures to attract about him a numerous body of followers. So used of a man who, for the sake of prestige or companionship, desires to have many people about him, but who is too selfish to treat them with that generosity which will win their esteem and make them contented to live with him.

83. Hange ha inu vai lolo: Like drinking oil liquid, that is, liquid adjunct to food into whose composition the expressed milk of the coconut has entered.

Coconut enters very largely into the preparation of native dishes and is also used alone as a relish to yams and vegetables in default of meat. The phrase indicates one who, if nothing better is offering, is quite ready to enjoy his food with a little coconut milk as the only relish. So used of a man who is easy to suit in the matter of food, and who shows no fastidious preferences.

84. Inu ti inu kota, Kakapapalangi fakatonga: Drink tea, drink *kota;* European fashion, Tongan fashion.

The *kota* is an infusion of fermented coconut which has been ground and strained. The phrase, which is of course modern, indicates one who at one time is anxious to adopt European standards and modes of life and at another clings to the old Tongan ways.

85. Jii a maanga ngako: Small mouthful (but) fat.

A small quantity of food which is tasty and luscious. Used generally of that which is small in quantity but of excellent quality. (Compare No. 203.)

86. Kai-aji fakatuha umu: Diner-out correspondent with food.

A man who keeps his eyes open and regulates his visits to other people's homes to correspond well with the times when a meal is to be got. (Compare No. 187.)

87. Kai halafaki: Eating on the short-cut.

This is not a very satisfactory translation. The word *halafaki* means to go round by some other track and wait on ahead for those who are coming along the ordinary road. As applied to eating the idea is to take food before the regular meal comes on, and thus to get ahead of others, waiting with satisfied hunger for them to catch up.

88. Kai malo ta-foa: Eating kindness that wounds.

Indicates a kindness that is spoiled by the way in which it is done, as of one who makes a present of food to another but accompanies his gift with unkind remarks. The recipient may eat the food but he is wounded by what it said to him. So generally of apparent gratification with that which hurts.

89. Kai meakai kovi: Eat bad food.

Get into trouble, be in difficulties.

90. Kai mea vevela: Eat hot stuff, that is, to get into trouble.

91. Kai melie: Sweet food.

Used of that which is specially good, or of persons of unusual excellence. It is used of Goliath in the best translation of the Bible into Tongan (that of the late Dr. J. E. Moulton).

92. Kai umu aipe foi i he ngaue ae malohi: Coward ever eating food through the work of the strong.

One of those bitter plaints, common the world over, of one man doing the work and braving the danger whilst another reaps the benefits.

93. Kaikai afua: Eating delicately, with special likes and dislikes.

Especially refers to the desire of a pregnant woman for particular foods, and used proverbially of conduct like that of a pregnant woman, or befitting a pregnant woman.

94. Koe kai ika pe ae jio ki motu: All the fish eating is looking at (or thinking about) an island.

If one stays at one of the small out-islands he will probably be well iced to get as much fish as he wants. Should one wish to go away for holiday on an island, and enjoy the plentifulness of fish, but finds himself unable to make the trip, as for example, through lack of a boat, it is said of him that all the fish he will be able to get will be by thinking about the island; he will have a purely imaginative treat. The expression is used of unsatisfied desires generally, as of a man who wishes to marry a particular woman but can get no further in his courtship than going to visit her and seeing where she lives.

95. **Koto kai a kui:** All the eating of a blind man; the reckless eating of a blind man.

Used of that which is done recklessly, ignorantly, like the blind man who cannot see to choose his food, but eats what his hand lights on.

96. **Kuhu te elo pato te emo:** Puffing at the stink smacking in licking, that is, to utter the wry-faced "pugh" characteristic of one offended by a bad smell, and at the same time to make the clicking or smacking noise of one who is licking up food.

Used of those who eat bad food in spite of its offensiveness.

Linguistically this is very interesting. The word "*te*" is apparently the article found in Maori and many other Polynesian languages (Hawaiian, *ke*) although not found, at least as an ordinary article, in either Tongan or Samoan.

97. **Longo moe fatu:** Silent with the belly.

Applied to one who sits silent under rebuke, making no effort to exculpate himself, but whilst he is thus tacitly accepting the blame of what is charged against him, he is also enjoying its benefits. The original idea is that of one who has eaten to full satisfaction where he had no right to eat. When reprimanded he sits silent accepting the blame, but he sits silent with a full belly.

98. **Pani puaka pani fonu:** Smeared with pig, smeared with turtle.

The pig and the turtle are favorite and valuable delicacies and will be found more in the abodes of the chiefs than anywhere else. For anyone to carry about on his person the smell of this rich fare is a sign that he is a person of some consequence.

99. **Nifo tuu he vale:** Teeth in a foolish man.

Good instruments thrown away on one who cannot use them. The wise man procures food for his teeth to chew, but the fool is unable to make this provision.

100. **Pipiko moe nifo:** Lazy with the teeth, lazy although there are teeth.

Men have teeth with which to eat, and hands with which to work and to get that which will satisfy the teeth. This is used of a lazy man who refuses to work and get that which will meet the legitimate demands of the teeth.

101. Teu ke hihi kae ola: About to cut out but gnawing.

This refers primarily to the coconut. A nut has been split open in order to cut the flesh out with a knife when someone greedily seizes it and chews the flesh out with his teeth, a thing befitting an animal or bad-mannered man. May be applied to a thing which is about to be carried out in a proper, decent way, but is actually done in an unseemly manner.

PRESENTING, BEGGING, KEEPING FOOD

102. Kai pe lea: Just eating speech.

Used of a man for whom there is no portion when the food presented to a chief is divided and distributed, but to whom the chief speaks. The individual thus honored by the chief will feel that he has after all some part in the ceremony although he has not received a present of food.

103. Koe ma ka te mate: Ashamed, but I'll die.

Used in the first place of begging food. What is the use of being ashamed to ask for food, seeing that if you do not get it you will die, or be very hungry. (It is very common in Tongan to say that one is *mate,* dead, of hunger, thirst, of desire for some thing, without indicating any extreme stress.) This expression is applied generally to making requests of any kind.

104. Motu ka nae navei: Broken but it was bound.

Navei are small cords passed through the top of a basket, especially of food, and fastened round the pole on which it is slung. These cords are not the main lashing, which is a long cord or vine passing several times round the basket and pole. The idea is that although the large lashing has been adjusted yet it is well to avoid risks by adding these auxiliary bindings. The expression has this sense of making assurance doubly sure. Sometimes the phrase is rendered, *Motu ka nae kavei,* which has the same meaning as the above except that the *kavei* is the main lashing. This, which seems to be more familiar to the younger generation of Tongans, may be applied to a mishap which has not been the effect of negligence. There has been an accident but those whose business it was to look after the matter in question evidently did their work carefully and thoroughly.

105. Puia a kaiaji: Sending a forager.

When one is sent to procure food for a party he will be the first to eat of what he has obtained. So used of one who is the first to reap the advantage of something that he has been sent to do, or to get.

106. Ua ma kae mae ma: Eat *ma* but be careful of *ma.*

Ma is the food made from fermented fruit. This expression indicates literally one who has a supply of *ma* of his own, but is very sparing of it, and when he wants to eat, begs food from someone else. Generally of selfish behavior of this sort. (Compare No. 134.)

107. **Tufa kau tufa:** Distribute. I'll distribute.

Primarily refers to one who is not satisfied with the share which falls to him in a distribution of food or goods, but who promises himself to even things up when his turn comes to direct the apportionment of gifts. Go ahead now with your distribution and give me this miserable little portion, but the time will come when I have my turn at dividing and it will be a small gift that you will get then. Thence used generally of tit for tat.

108. **Tuku umu fakavajivaji:** To leave food in the Vajavaji way.

Vajivaji is the name of a people in Fiji, who when they take a present of food to anyone have the custom of waiting to get a portion for themselves. This has become proverbial in Tonga for giving a thing and then asking for a portion of it.

109. **Umu pouli kae ai hoota:** Food in the dark but with a friend there.

When food is taken up from the oven in the dark there will be more or less of a scramble in which some are likely to come off badly, but a man who has been so placed that he cannot very well look after himself will yet fare very well if he has a well placed friend who is mindful of his interests. It is applicable to those cases, very numerous in civilized as in more primitive societies, where in the distribution of favors the influential man on the spot remembers his less advantageously situated friend.

110. **Uto taunga mo kuma oku ua:** Coconut pith put away to keep and two rats.

The *uto* is the sweet spongy substance inside a coconut which has germinated. It is frequently eaten, as a sweetmeat rather than as a regular food, and was particularly used to pacify children. Should some of this be put away to keep for another occasion and one rat find it out there will probably be something left over for the original owners, but if two or more rats get to work on it the whole will soon be finished. So the expression is used of anything which the owner is reserving for himself, and which other people, not merely a single person whose appetite might be satisfied while there is still something left, but a number, find out and wholly consume.

DOING OF TASKS. CRITICISM

111. **Fai faka-muomua-nima:** Do with front of hand.

Doing a task half-heartedly, touching it, as it were, only with the tips of the fingers instead of grasping it heartily and sincerely with the whole hand. (Compare No. 416.)

112. Fakamohe mei ulu: To put to rest from head.

Used of that which is near at hand; a task that must be accomplished in the immediate future. The picture is that of a man who lies down to sleep with his working waist-cloth or his tools placed near at hand, both as a reminder of his task and to be easy of access when he awakes in the early morning. It is also used of something which is lying just ahead in the journey of life. *Fakamohe,* put to rest, besides being used for example, of putting a child to sleep, is also used of placing, putting, inanimate things. This latter sense fits best with the context of the phrase.

113. Fakaanga i hiku mamao: Criticise (something) at extreme distance.

An admonition that if you want to offer criticisms or advice upon anything, choose something that is well within your own experience and knowledge. Keep quiet about what you don't understand.

114. Fakaanga i tefito'i niu: Criticise at the foot of the coconut tree.

One who stays on the ground but is lavish with his advice to the man who has climbed the tree. Generally of the man who stays out of a job but has plenty of talk to offer to the one who has gone into it.

115. Fili akau vaivai: Picking weak tree.

Choosing an opponent in a contest who is not very formidable; generally looking out for a soft thing, like the woodman who picks an easy tree to cut.

116. Fokotuutuu ae fefie hu: To stack up almost rotten firewood.

A pile of such wood may make a considerable display, but when used will be quickly consumed. It will prove in fact to be a big stack of hollow pretension.

117. Hala i tangata ia: Being without man, that is, there is no man to carry out what is desirable.

A certain work languishes because it has no man fit for it. The expression is used also in rebuke of someone who misbehaves himself where there is nobody able to check him. You misbehave yourself in this way, but only because you are without a man, because there is nobody here to punish you.

118. Muomua puke fue: Grasping *fue* in front.

The *fue* is a creeping plant with strong tough stem, used anciently as a rope for drawing heavy loads. When a team of men was dragging a load the man in front just held the line and did very little of the actual work. So of a man who seems to be on the job but is in reality putting very little real work into it.

It is also explained as referring to two or more people going through the bush together, walking in single file as the Tongans invariably do, when the front man, grasping a branch and holding it out of his own way, lets it fly back in the face of the man following. This is the explanation given by Baker, but although he had opportunities of getting correct elucidations denied to the present day investigator, yet the other application of the expression has much to recommend it.

119. **Taki taha tali hono vaha-ngatae:** Each one accept his duty; each one do his duty.

The word *vaha-ngatae,* translated "duty", is commonly and probably correctly explained as meaning literally "between the *ngatae*". The *ngatae* was used as fencing posts or for marking lengths of the fences in the compounds of high chiefs. When the people were mustered to build the fence they were assigned to do so many spans between the *ngatae,* and thus the distance between the *ngatae* came to be used in the sense of one's share of a task, duty.

120. **Ojiki a velenga:** Finished desire.

The division of this phrase into its component words, and the literal translation, are conjectural, but the sense in which the expression is employed is that of doing to the utmost of one's power.

121. **Ta fakalanga ta:** Stroke arousing stroke.

When workmen are weary and are resting they will be stirred to recommence their labor if one of their number gets up and starts working again. Used also of a remark which arouses antagonism, and begets strife and argument.

122. **Tuai kae ngai:** Slow but moving on gradually.

Has its obvious meaning of that which cannot make any great pace, but nevertheless keeps advancing.

Another form, apparently modern, is *Tuai kae nga'i,* which means slow but creaking, that is, creaking on its way; the idea being that of a cart moving sluggishly and creakily. The application is the same as above.

123. **Tuu kau oi:** Stand I shall grunt, groan.

Used by a weak or aged man to himself as he forces himself to get about some work. Come on old chap, get to it even if it does make you groan.

124. **Valevale malohi:** Unskilled (but) strong, or a strong unskilled person; an unskilled person who works with a will.

A man who has no special skill but who works with all his might ("does strongly" as the Tongan idiom has it), is more satisfactory than a skilled man who is idle and slack ("weak at working" in Tongan idiom). A rather less complimentary shade of meaning may be conveyed by this phrase, namely, it is the way of the unskilled (or foolish, the same word is used in both senses) to go ahead with all their might at a job although they may be all wrong.

125. Veuveuki ke lelei: Upsetting for good.

Veuveuki means to introduce confusion, to wrest things from their right order, to change instructions that have been given about a piece of work. This phrase indicates one who refuses to obey orders, makes a change in the instructions given, or otherwise disarrays a job, but does it in the knowledge that the prescribed method of procedure is not a good one. Such a man introduces confusion into the task, but it is a confusion that turns out well.

MANUFACTURES

CLOTH

[Cloth is made by ingeniously pasting together lengths of the beaten-out bark of the paper mulberry *(hiapo, Broussonetia papyrifera)*, on which a design is stained and picked out with black coloring matter.]

126. Hafuhafu koka: Dripping *koka*.

The *koka (Bischoffia* or *trifoliata javanica)* furnished a red dye for staining the native cloth. This dye is obtained by mixing the grated wood of the tree with water and squeezing through a mat. The imagery of the expression is taken from the drops of liquid falling down from the strainer, though when the mat has just been freshly filled the liquid runs down in a full stream. This expression, however, evidently refers to mere drops, more particularly perhaps the hard won drops when the mixture has been strained almost dry. It is applied to eking out a thing, trying to make it go round.

127. Hange ha fakatau kupeji: Like buying a printing-frame.

The printing-frames for the native cloth are highly valued, and when it comes to buying one there is apt to be a good deal of haggling. So this expression is applied to a transaction marked by confusion and cross purposes.

128. Hange ha fau tau koka: Like a strainer for expressing *koka*.

A coloring matter for staining the native cloth is obtained from the *koka* tree *(Bischoffia javanica)*. To obtain this pigment small pieces of bark are scraped from the tree, mixed with water, and then strained through a mat. This mat, which is long and narrow, is wrapped round the ground bark, and assumes the shape of a huge sausage. The ends are then tied over the branch of a tree so that the mat forms a loop hanging down to a convenient height. A pole is put through the loop, and manned (or "womanned") by several people who turn the pole round, thus twisting the strainer up tight and expressing the pigment which runs into a receptacle placed to catch it. This mat in the course of twisting is subjected to a great strain but is hard to break. The expression is used of a lazy person who, although he is the subject of many admonitions and rebukes, is yet very hard to shift.

129. Maamaa a hiki papa: Shifting the tapa board is light.

The *papa* is the long hollow board, or rather wooden structure, used in printing designs on the native cloth. It is fairly heavy and requires two or three people to lift it about. The idea of this expression is that one who wants to borrow one of these printing boards for cloth making in his own home finds no difficulty about securing the necessary help to lift it, but when it comes to returning it to its owners there are constant difficulties in the way.

130. Nae li ki fe hoo geeji kahi? Where did you throw your *kahi* shell?

The *kahi* shell (*Arca scapha*) is used as a scraper in the preparation of the native cloth. This phrase is a reply to one who goes to beg cloth from another. What did you do with the shells for making scrapers that you have not got a stock of cloth for yourself? The expression is not confined to those who beg cloth, but is extended generally to those who find themselves in want of a commodity which they might reasonably be expected to supply for themselves.

131. Tai e oko atu: The coloring matter will run on, that is, the coloring matter with which one part of the cloth is stained is that with which the adjoining part will also be colored.

This expression is used as a reproof and warning to those who jeer at the misfortunes which have come upon another. Just as the color on one section of the cloth is repeated on the next and each part in turn comes to be stained, so will he who today scoffs at the afflictions of another find himself in his turn involved in the like misfortunes. It is applied especially to the infirmities of old age. The strong man may laugh today at the weaknesses of age, but his own turn will come.

132. Tuu tai: Coloring standing, that is, a thing in which is the coloring matter used in staining the native cloth.

This phrase is not properly classed as a proverbial expression but is always written and felt as a single word, meaning beautiful, handsome, whether of physical feature or of conduct.

OTHER MANUFACTURES

133. E homo ae hui a Lafi: The needle of Lafi will be parted with, that is, will be parted with more easily than the thing that one proposes to do will be accomplished.

Lafi is said to have been the first to use the bone needle and whale's tooth in the manufacture of certain articles. His needle, or piercing instrument, was naturally not a thing to be given away lightly and obtaining the needle has become proverbial for that which is difficult of attainment. (Compare Nos. 340, 358 and 370.)

134 Haihaija Kae heheia: Bound up yet wandering about.

The thing that is bound up is wealth, and its owner does the wandering about. Tongan wealth, consisting largely of mats and cloth, is tied up in bundles and kept in the rafters of houses. One who is not well provided with these necessaries of life will be likely to go about looking for someone of whom he may beg a supply. This expression indicates one who, though possessed of ample store himself, keeps his own goods carefully bundled up at home and goes about seeking assistance from the bounty of others as though he had nothing of his own. (Compare No. 106.)

135. Hange ha fala kuo fofola: Like a mat spread out.

Applied to a calm sea, also generally to anything with a smooth surface.

136. Hange ha lali foa: Like a cracked drum.

When the native drum is broken it is not usually thrown away but is stowed in the house where obviously it must often get in the way. The phrase is applied to useless people who merely take up room about a place.

137. Nifi eni kae nafa e: Little this but great that, that is, this is nothing to what there is going to be.

The word *nafa,* translated "great", means really the Tongan drum which consisted of a bundle of lengths of bamboo, closed at one end and open at the other, so arranged that half the openings were at one end and half at the other. A mat was wrapped round the bundle of bamboos, but leaving the ends exposed. The instrument was not stood on end, but laid lengthwise, and beaten with two sticks on the upper surface. In contradistinction to *nifi,* small and thin, the drum is used here as the symbol of that which is large and bulky.

138. Nimo i talafau: Hidden in the *talafau.*

Talafau is the space between two rows of plaiting on the bottom of one type of basket (called *kato fakaono*) of rather superior design and used only for things that will not soil it. A small article might be concealed in this space and apparently lost; it is not really lost, however, but is there all the time. Used of that which seems to be lost but is not really so.

139. Papata ka nae lalanga: Coarse textured but woven.

This is an image from mat weaving. Although the weaving may not be first class yet it will give greater satisfaction to the one whose own handiwork it is than will another mat of better construction. The satisfaction of accomplishment.

LAND CREATURES

140. Foki e kuli ki he ene lua: The dog returns to its vomit.

Probably, almost certainly, a mere adaptation of the Biblical expression, (compare No. 150).

141. Hange ha kuli fie jikoa: Like a dog that wants to defecate.

A dog who happens to be shut in a room and wants to defecate will run anxiously from door to door seeking a way out. Applied to a person who cannot keep still in a room, but keeps shuffling about and changing his seat.

142. Hange ha kuli viku: Like a wet dog.

The dog after bathing in the sea runs and jumps about with evident marks of the greatest pleasure. Used of one bustling and running about, and obviously bubbling with joy.

143. Mohemohe ae kuli pea fafangu: The dog is sleeping and is waked.

This is exactly like our English "Let sleeping dogs lie." The expression is said to have been first used with respect to a great man-eating dog named Fuhibubuta, which lived in a cave at Motuliki in Fiji. Tradition has it that this dog, after having destroyed all the inhabitants on his island except two brothers and their sister who eluded him by hiding in the bush, was killed by Maui Kijikiji. Another legend attributes the exploit to Muni. The origin of the expression has also been referred to the dog which formed part of the temple furniture of the god Pulotu Katoa (Whole of Pulotu) in eastern Tongatabu.

144. Hange ha pili efihia: Like a squeezed lizard.

The *pili* is the pretty little blue and green lizard so common in Tonga. He is slenderly made and if squeezed, as for instance, by being caught between two sticks, would present a very attenuated figure. Used of a very thin person.

145. Liu ka moko: Lizard climbing upside down.

The lizard comes down a tree head first, and there is occasionally a man so skillful in climbing that he is able to imitate the reptile in this. To such a man this expression would be applied, but it is used generally of one who has some special way of his own of doing some particular feat or who possesses some extraordinary skill that enables him to bring off feats that the ordinary mortal would scarcely attempt.

146. Moko looa: Choking lizard.

Applied to a person whose neck is stretched out like that of the lizard in his distressful attempts to swallow. (Compare Nos. 167 and 177.)

147. Kuma aka ki he pusi: Rat kicking at the cat.

Generally of the weak behaving presumptuously to the strong.

148. Pekopeko a pusi kai moa: Quiet mournfulness of a cat that eats fowls.

The hypocrisy of one whose sad-eyed propriety in the presence of others is belied by the mischief to which he readily turns when free from observation is likened to the conduct of the cat whose demure abstention from chicken flesh does not outlast the presence of human observers. (The cat, with its English name *pusi*, is a late introduction.)

149. Pakau a puaka tuu a: Leanness of a pig kept in a sty.

The pig kept in a sty does not become so fleshy as the pig allowed to wander freely, but when put to the test of eating the pig from the sty is found to have more fat on him than his brother who enjoyed greater liberty. So used of that which is lean to the eye but is found to have much fat.

150. Puaka ne maa toe fakapelepela: A pig that was clean again covered with mud.

Equivalent to the Biblical saying about the sow that had washed turning to wallowing in the mire, and possibly a translation of it.

151. Pukepuke a fufula: Grasping a big fat pig.

This is a task that demands the whole of one's strength and care. Tradition says that a big prime pig used to be kept in a sty in Taanea in Vavau, and that Maui Atalanga and his son Maui Kijikiji went to get it. As the younger Maui went to lay hands on the animal his father exhorted him to grasp it firmly lest it escape. This incident, however, does not seem to be claimed as the origin of the expression.

152. Hage ha fononga pulumokau: Like a troop of cattle.

Pulu-mo-kau, bull-and-cow, is used as a name for either bull or cow. It is of course recent. Applied particularly to great waves at sea and also generally to large things.

153. Hange ha pulu kuo ta-halai: Like an ox that is struck badly.

Obviously modern, since the introduction of cattle. The picture is that of a slaughterer who has missed his aim and only wounded the animal. The ox in its pain bellows aloud. Applied to one who laments or weeps without restraint, at the top of his voice.

154. Taupuji hosi: Touching horse.

It is possible that the latter part of the first word is the introduced name for cat, *pusi,* in which case the literal translation would probably be, Cat touching (perhaps fighting) horse. This, however, is by no means certain. The phrase is applied directly to a child taking liberties with a horse, with the chance of earning a kick by his temerity. It is also used generally of running into unnecessary danger. The expression dates from the introduction of horses and would seem to have originated when horses were still new to the Tongan people, and objects of more or less awe. The Tongans of today, even quite young boys, are fearless riders.

155. Ji namu tae feongoongoi: To kill a mosquito without giving warning (more literally, without mutual understanding).

If one sees a mosquito on a companion and gives it a slap the kindly office will perhaps not be appreciated if the blow takes the human recipient too much by surprise. Instead of gratitude anger may be evoked. So one must be sensible about the way in which even the best meant services are rendered.

156. Ngali ha liha: Like a nit.

Rather an abusive way of alluding to small things.

157. Oji e neveneve: The *neveneve* will be finished.

A phrase meaning very many. The *neveneve* is the nest and young of one of the spiders found in Tonga. The nest when opened is always found filled with a very numerous progeny, and so it is said of a great multitude that one will sooner finish counting the *neveneve* than be able to reckon so large a number.

158. Oku lau pe e he mokohula oku ikai ha ua oe lalo takapau: The earwig reckons there is no place like under the mat.

The earwig lives under the mat and if disturbed runs back there for shelter. To him this is the finest place in the world. Used proverbially of out-back folk who have no conception of anything finer than their own restricted surroundings.

159. Tuakoi a ofato: Mutual support of the *ofato.*

The *ofato* is a grub that makes its dwelling in rotten wood. In the Tongan group it is apparently found only, or chiefly, in Niua Foou. These grubs, however close together they may lie, never quite touch and will be found always to have a thin layer of the rotten wood between them. The expression therefore indicates those who should be in the closest possible contact and give the greatest support to each other, but who do not do so. Beside the ordinary Samoan term *afato,* Pratt (Grammar and Dictionary of the Samoan Language) gives *moe'ese'ese* as a name for this grub. *Moe'ese'ese* means "sleeping in different places" and apparently refers to the same peculiarity as is noted in the Tongan proverb. [For a description of the *ofato* (Samoan, *afato*) see Krämer, Samoa-Inseln, Band II, p. 430.]

BIRDS

160. **Hange ha moa liaki kovi:** Like a hen deserting badly.

Refers to a hen who deserts her chicks before they are able to fly to a roost and look after themselves. Applied to parents who neglect their children.

161. **Hange ha momoa fiji:** Like a handsome cock.

This is not quite literal, the word *fiji,* rendered handsome, being one of the descriptive terms applied by the Tongans to fowls, and indicating a dark plumaged bird that is reckoned the finest looking of all. Applied to a man of handsome bold aspect.

162. **Jitua kae kio:** Gone away but squeaking.

The picture is that of a man who has stolen a mother hen from her chickens. He gets off unobserved with his catch but leaves the young ones squawking until they attract attention and the theft is discovered. Used of the traces which one leaves of his wrong-doing and by which he is found out.

163. **Lilolilo pea kio:** Hidden and chirping.

A young chick hidden from sight will chirp and thus make itself known. Thus an action may be done secretly but there will be some slight indication by which it will be betrayed.

164. **Kai lalo hakalo:** Eating under the coconut scraper.

Coconut broken into small pieces by a scraper is very commonly used for feeding fowls. The thoroughly tame fowls will come and eat the nut as the pieces fall from the scraper but the wilder birds will not venture near. Used of giving up wild shy ways and becoming thoroughly domesticated.

165. **Kainga a moa taane:** Friendship of a breeding cock.

A couple of roosters may be friends but there will come a day when they will fight. Two high-spirited warriors may be friends but they are likely to fight at last. Friendship between those who are apt to fight with each other.

166. Kio mo kokono: Literally chirping and straining.

A name applied to chickens. Rather an abusive epithet applied to persons meaning that they are chickens, that they cannot do much and what little they do is only accomplished with a good deal of straining.

167. Moa looa: Choking fowl.

Applied to one who is nursing some sting; or who for some other reason sits with uplifted head and preoccupied stare. His attitude is likened to that of the straining fowl. (Compare Nos. 146 and 177.)

168. Moa tangata fie moa taane: Cock who wants to be breeding cock.

"Breeding cock" is perhaps not exactly a literal translation of *moa taane* which means rather a fine, big, specially strong cock. Birds of this stamp, however, are kept for breeding purposes and to discharge the responsibilities of caring for a family. More ordinary cocks find their way to the pot or, more strictly, the banana leaf. This indicates the conceit of an ordinary rooster who wants to be like his big strong brother. So of the little ordinary chap who gives himself the airs of his betters.

168. Hange ha veka kui: Like a blind rail *(veka, Rallus pectoralis)*.

Wild, uncoordinated action such as might be expected from a blind bird.

170. Kai pe tae hoo veka: Eat the excrement of your rail.

Eat the fruit of one's own work. Used in reproach to one who is enjoying by himself the reward of his labor, by those who think that they should have shared it with him.

171. Kaukau faka-veka: Bathing like a rail.

The rail is not very fond of water. The expression is applied to a human being who manifests the same distaste.

172. Kiki tou veka: Young rail generation of rails.

The young bird is not in the same generation with the full grown birds. Used by anyone who wishes to emphasize that another is much older than he. I am no more in the same generation with so-and-so than the young rail is in the same generation with the full grown bird.

173. Taka tahi a veka: The rail going about at sea.

The rail may fly down to the sea or, in ancient days, may have been taken on a voyage by those whose god he was, but in spite of his proximity to the water he does not bathe. Used of one who goes down to the sea but does not take advantage of the opportunity to bathe; is contented to remain dirty.

174. Tolo veka aki paanga: Pelting the rail with money.

Apparently a late phrase coined since the arrival of European money. The word *paanga,* money, is also employed to designate the large flat beans or counters used in the game of *lafo.* The reference to money seems more likely. To kill the rail with pieces of money is doubly foolish. Not only is the ammunition wasted but the rail is of little use when he has been killed.

175. Tolongia pe veka kae ofi: The rail is pelted only when he is close.

If the bird does not come near the haunts of men there will be nobody to pelt him. In the same way people will not find themselves annoyed or burdened by the commands of chiefs if they keep at a distance from them.

176. Aoto e manu ki Toku: The bird settles on Toku.

Toku is an islet in Vavau whither sea-birds resort in large numbers. The birds may fly far out to sea looking for food but they make for Toku to rest. Used, for instance, of a man coming home to close his days, or jocularly of a lover making for the home of his sweetheart.

177. Hange ha lupe kai kotone: Like a pigeon eating nutmeg.

The pigeon straining to swallow a nutmeg nearly chokes himself, and has to stretch up his head and neck to get the nutmeg down. Used of one who has something on his mind, or who for some other reason sits in company with his head up and an absent-minded expression. The appearance of such a one is compared to that of the straining bird. (Compare Nos. 146 and 167.)

178. Hange ha mata'i moho vao: Like the eye of a wild *moho.*

Moho is the name of a bird. It is very rare now but has been seen on the island of Eua. Its eye has a beautiful red iris. The expression is used of a handsome face.

179. Hange ha tavake ta mafua: Like a tropic bird striking its prey.

Graceful action is here likened to the beautiful sweep of the bird's flight as it comes down to the surface of the sea, the attractiveness of its appearance being further enhanced by its striking tail feathers. (Compare No. 36.)

180. Holo ae miji ki he ovava: The *miji* flock to the *ovava* (*Ficus prolixa*).

The *miji* (*Aplonis tabuensis*) likes the little berries of the *ovava* tree, and flies to the *ovava* in preference to any other tree. The *ovava,* moreover, is a large noble tree and the bird may be supposed to be attracted by its distinguished appearance. The application is that people like to flock to the home of a chief or of a wealthy man.

181. Kai aipe manu vaivai i he fangota ae lulutai: Weak animals are just eaten up when the *lulutai* goes fishing.

The *lulutai,* which would seem to mean literally the sea-owl, is alleged to have been a great bird and is identified, though without certainty, with the mythological *kanivatu,* the huge bird to whose breast Kae clung and was borne across the ocean from Pulotu to Samoa. With regard to this proverb it is said that when the *lulutai* went out for fish the larger sea creatures, such as the whale, were the object of his quest to be taken home to his haunts. Smaller creatures were merely tit-bits casually swallowed by the way. So do the strong prey upon the weak, destroying and consuming them as a thing hardly worth noticing.

182. Lofa tala matangi: Tern telling wind.

The appearance of the tern (Sterna sp.) indicates the approach of a hurricane. Expressions of this sort are capable of much the same application in Tongan as in English; for example, when you see So-and-So coming you always know that something is the matter.

183. Lulu taki lulu: Owl leading owl.

Used generally of the mating of things that suit each other. It is said to have originated with the marriage of Fifita Puku, son of the Tui Haangana, with Fatafehi Lapaha, the Female Tui Tonga. Both man and woman were exceedingly handsome.

184. Mamahi noa ngutu o fuiva: Mouth of fly-catcher (*Myiolestes heinei*) labors in vain; or labor in vain of the mouth of the fly-catcher.

The fly-catcher has a sweet note, but his singing is mere waste of time so far as getting food is concerned. So used of anyone who goes to much pains but gets no fruit for his labor. This expression was used of a chief who was vainly assiduous in his addresses to a lady.

185. Tengetenga utuaki maa miji: *Tengetenga* carrying (food) for *miji.*

Tengetenga is a local name in Niua Tobutabu (Keppel's Island) for the *fuiva* (fly-catcher, *Myiolestes heinei*); *miji* is also the name of a bird (*Aplonis tabuensis*). The *tengetenga* is the smaller of these two birds, and the phrase is used for the weak helping the strong, "the poor feeding the rich." (Baker.)

186. Molumalu faka-kaka: Fine like a parrot.

The parrot (*kaka*) found in Eua has an abundance of handsome plumage and with his feathers on looks a large full-fleshed bird. Divested of this showy covering his body is found to be small and thin. Applied to that which is showy but is found to be of little worth.

187. Pekepeka jio ohuafi: Swift seeing smoke.

The swift (*Collocallia spodiopyga*) is attracted by the smoke of fires. The expression is used of a person who is constantly making for the fires of his neighbors, that is, who prepares very little food for himself but when he notices the culinary smoke ascending from some other home invites himself there for dinner. The Tongan is very open-handed, but this chap rather overdoes the giving of opportunity to other people to prove that it is more blessed to give than to receive. (Compare No. 86.)

188. Pikipiki aho: Wings folded by day.

Night birds sit with wings folded during the day. The expression is used of those who don't do much by day but who prowl about at night, very often getting into mischief.

189. Tee pato: Duck excrement.

The missionaries were the first to bring the Muscovy duck to Tonga, and people who were specially anxious to appear well in the eyes of the missionaries would not hesitate to assist them by cleaning up the mess made by the ducks. The expression, therefore, is used of one who does all he can to secure the favor of the missionaries.

190. Vea tee peka: Vea flying-fox dung.

A man called Vea lived for a long time with a great chief but at last did something for which he was punished. Spoiling one's prosperity or long service by a fault.

FISH

191. Angaanga mo fai: The name of a shark whose head is like that of the *fai,* sting ray, and whose tail is like that of the shark called *anga.*

Applied to those of uncertain character, now one thing and then another.

192. Faka-ikeika-lahi: Like a big fish.

Applied to one of a bold resolute deportment.

193. Fakalelei a tukuku: Peace-making of a *tukuku.*

The *tukuku* is a small fish (one of the Glyphidodon). This is used derisively of the little chap trying to make things right between those who are bigger, or socially superior, to himself.

194. Fotu ae ulua ngalo ae tukuku: The *ulua* appears, the *tukuku* is forgotten.

The *ulua* and *tukuku* are two fish, the *tukuku* being small and bony, and the *ulua* large and fleshy. If fishermen are catching the *tukuku* and the *ulua* appears they will at once leave the pursuit of the inferior fish and confine their attention to the newcomer. This expression lends itself to numerous obvious applications but seems especially used of a girl who is being wooed by a man of low degree when a chief steps into the arena and also becomes a suitor for her affection. The small fry will at once be neglected in favor of the more lordly catch.

195. Mau e tukuku o ave maa Talanuku: Get a *tukuku* and take it to Talanuku.

This is equivalent to "Carrying coals to Newcastle." Talanuku was a great chief, though it seems to be forgotten just who he was; at any rate our inquiries have not yet succeeded in placing him. To him of course flowed the food and wealth of the country. The *tukuku* is a small bony fish.

196. Hange ha ulua ha heli: Like an *ulua* (mackerel) lashing *heli*.

The *heli* is a small fish, usually found swarming in large numbers. When the large vigorous mackerel charges in among these small fry he makes a great dispersal. Used of a man who charges in strongly scattering other people, things, difficulties, to left and right.

197. Hange ha ulua oho-kai: Like an *ulua* rushing for food.

The *ulua* (a mackerel) is a large vigorous fish, and when he is pursuing other fish he presses his attack strongly. Applied to one who when he has any work on hand goes into it with all his might.

198. Hange ha fanau a ha fonu: Like a turtle's family.

The turtle lays her eggs in the sand and leaves them there to hatch. About the time when the young turtles should appear the mother is reputed to re-visit the spot where she laid her eggs and to take up her station at the edge of the water. As the young turtles make their way down to the sea the mother seizes them and eats them. Only those who do not take the straight track to the water, but go off to one side or the other, escape their unnatural mother. The expression is used of parents who are unkind to their children or of persons generally who are unkind to close relatives.

199. Hange ha ika kuo vae: Like a fish that is divided.

This refers to a fish whose flesh is marked with clearly defined divisions. Applied to that which is well divided, as a speech skillfully broken up into appropriate headings.

200. He oku ai ha ika e lele ki he hiku: What, is there a fish that will swim (run) towards the tail?

The fish swims forwards, headwise, not backwards, tail-wise. The expression has a special application to the family, which is naturally reckoned rather to the father (the head) than to the mother (the tail). Instead of the word *hiku, mahi*, which means the tail, is sometimes used.

201. **Hola ae fai kae tuku ae foto:** The sting-ray has gone but the barb is left.

When the sting-ray strikes with its tail the barb that enters the body struck is commonly broken off and left in the wound. The fish may swim away but the poisonous, wounding, painful barb is left. Those who have caused suffering may have gone away but the mischief wrought by them still persists. The evil men do lives after them.

202. **Ika faao:** Predatory fish; fish that prey on other fish.

It is explained as primarily relating to a fish which comes and seizes a smaller fish from the hook of a man who has caught it, thus violently capturing the fisherman's property. This is well in keeping with the literal meaning of *faao*, but the expression is used generally of one creature which preys on another.

203. **Jii a maanga ika maka:** Small mouthful (but) rock fish.

The Tongan words *ika maka*, translated "rock fish," indicate fish found under the rocks, at the bottom of the sea, or far from land, and which are of superior quality to those found close inshore or near the surface. The phrase means, therefore, that which is small in quantity but of good quality. (Compare No. 85.)

204. **Lakulaku tee-feke:** Handling black secretion of octopus.

Although the black secretion found in the head of the octopus is eaten with the rest of the fish, it is handled gingerly on account of aversion to its color. The expression is applied particularly to one who is not expert in preparing kava. Instead of grasping the strainer or kava firmly and masterfully the inexpert operator handles the materials diffidently and awkwardly.

205. **Luki tenifa i hono tahi:** Challenge a shark in his own sea.

This species of shark, the *tenifa*, is large and fierce and will attack men. The folly of jumping into the water just where he is and challenging him to single combat is obvious. So the phrase indicates the foolish effrontery of challenging one to contest in that wherein he is superior or under circumstances which give him a marked advantage.

206. **Mohemohe a tenifa:** Dozing of *tenifa*.

The *tenifa*, a large fierce shark, may doze, but when he wakes he wakes to violent activity. Applied to one who is spasmodic; he is inert at one time but at another is working with fierce energy. (See Nos. 207 and 208.)

207. **Mohe faka-tenifa:** Sleep *tenifa* fashion; *tenifa*-like sleep.

The shark *tenifa* is a very long and sound sleeper; his slumbers sometimes lasting for a day or more. Applied to people who sleep long and soundly.

It is said that a man of Vavau out one day in a canoe saw a *tenifa* lying asleep below the surface of the sea. He dived and fastened a rope to the shark's tail, returned to his boat, which he overturned and sat on the upturned bottom. He then waked the shark, or else it waked of its own accord, and let it drag the boat wherever it would till at length it was exhausted. He then was able to get it ashore where the people killed it and probably ate it. This story is vouched for as true and there is no reason to doubt it.

208. Hange ha tenifa: Like a *tenifa.*

Applied to persons of fierce, destructive temperament.

209. Mata ika fai ki he pupua: Looking at fish in a whirl-pool.

Fish in the deep swirling waters found both in holes in the reefs and in places out at sea will be very hard to get, however longingly one may gaze at them. The expression is used of something that one desires but is unable to obtain.

210. Tafitafi o: Sweeping *o.*

The *o* is a small fish of considerable repute and evidently energetic and daring. When this fish appears the other little fishes in the vicinity make for shelter; he sweeps the sea clear. When a great man appears the smaller fry quietly disperse.

211. Tau ae ika taane: Fight of great fish, as of sharks or swordfish.

When battle is joined between these strong fierce monsters of the deep the sea is churned into foam; the contest is long and stern. So used of the struggles of redoubtable champions.

212. Tau ae lei moe tofuaa: The whale's tooth befits the whale.

A big thing becomes a big person.

213. Te leleva te pokumei: *Leleva* floating, *pokumei* floating.

The *leleva* and the *pokumei* are two sorts of fish, of which the *leleva* is held in high esteem but the *pokumei* is comparatively disregarded. The phrase is used of people of little importance making preparations for anything in imitation of those who cut a bigger figure. For example, it might be spoken pleasantly to children who want to go out anywhere because they see their elders about to go.

FISHING

214. Ai ke mahae pea toki pena: Let (it) be torn and mended afterwards.

Refers primarily to a fishing net. Go on using it as much as you like and if any damage is done to it, it can easily be repaired. Employed generally of other things besides the fishing net, but with the same meaning.

215. Aunga mo kaunanga: Fishing with a servant woman.

Aunga, translated fishing, means rather the place where the fishing is done, or other rendezvous. The meaning is to have an appointment with one who is under the orders of another and is not free to see the sport, or what not, for which the meeting was arranged. It is also used of, say, fishing in company with one who wants to take the fruit of the sport to the chief, keeping none for the fishers.

216. Fangota fai ki he kato ava: Fishing into the basket with a hole in it.

This expression is analogous to such English expressions as "carrying water in a sieve." It is said to owe its origin to the ruse of the legendary hero Longopoa who sailed to Pulotu, the Tongan Paradise and Abode of the Dead. Longopoa wished to find his way back to Tonga but did not see how it could be managed. At length he saw his opportunity in a fishing expedition of some of the gods of Pulotu in which he was invited to join. Being entrusted with the basket into which the spoil was to be put, he made a hole in the end of it and as fast as the fish handed to him by the divine sportsmen were put in they fell out through the hole. In this way the fishing excursion was prolonged until the party reached Tonga, as Longopoa had forseen and designed. As they were fishing the gods would now and again ask, "How's our basket? Full yet?" And Longopoa would as often reply, "No, there's still room." At length the gods exclaimed in surprise, "Why, this is fishing into a leaky basket."

217. Fetuiaki a kupenga tutui: Mixing of fishermen who go straight through entanglements.

Tutui means to go right through obstacles, as one who bursts through jungle or brush. The phrase indicates fishing parties who have come into close proximity, but waste no time in talking to each other or even in exchanging the civilities that the rank of any of the fishers might ordinarily demand. Fishing, moreover, was an occupation that did not wait on man, the proper times for the fish being marked by moon and tide; it is a case of now or never. The expression is applied to people or parties of workmen who will not be diverted from their occupation by outside interruptions.Baker gives: "The contest of two persons or parties equally strong or courageous."

218. Hala kea ahia: Faulty but tried.

Nets and snares for both land and sea creatures were examined and tested. It might happen that the sportsmen at last weary of trying to correct a weakness or fault in their net or snare, determined to give it a trial, when, although not very optimistic of the result, they make a fine catch. Never mind what the net or snare is like give it a trial, who knows what luck we may have?

219. Hage ha pa iloa: Like a famous hook.

Fish-hooks were named and their reputations known and spread abroad. This expression is equivalent to saying famous, well known.

220. He koe liko? What, is it the *liko?*

The *liko* is one form of fishing net honorably distinguished by the large number of fish caught with it. This expression deprecates unduly optimistic expectations; Why, is it the *liko* that you are out with, that you expect so much?

221. Hoholo ae pa he gutu oe valu: The hook near the mouth of the *valu* (a large edible fish).

The fish is likely to swallow the hook, hence of temptation to which one is specially liable to succumb being put in his way.

222. Jia kupenga he ua: Weaving net because of the throat.

One who is not a skilled fisherman but who by force of hunger is driven to weave himself a net, but after all because of his lack of skill is unable to do anything useful with it. Generally of one who is driven by circumstances to make some attempt but is unable to carry it through.

223. Jiu a tama: Son away fishing (for the bonito or shark).

Indicates a woman who is watching day and night for the return of her son from sea.

224. Ka ai ha mala to ki uta: If there is a curse let it fall to the shore.

This does not seem to have any proverbial application, but is an expression used by the fisherman when bad luck dogs him. Fishing is an exceedingly ticklish operation and cannot succeed if disturbed by broken tabus and malevolent sprites. We might almost call this phrase a prayer of the fishermen. Let the curse leave them and go ashore so that they may have good luck.

225. Koli tali aho: Fishing waiting for day.

This is used of the procrastinator. During the day time a group of people may say that they will go fishing when night comes (the word *koli* refers to fishing with hand nets), but when the darkness falls there may be those too lazy to carry the plan through and who make some excuse to stay at home. These idle wrigglers out of their job are the ones stigmatized in the expression.

226. Kupenga e tautau kae fangota: The net is hanging but there will be fishing.

Hanging nets out to dry is a sign that the fishing has ended, but this expression indicates that operations have only been temporarily suspended. A party that has had bad luck may give over for the time but with the resolve soon to try their fortune again; they are hanging up their net but there is going to be more fishing.

227. **Mala nima:** Bad luck (of the) hand.

Bad luck, or curse, that is not a visitation of the unseen powers but arises from the awakwardness or folly of man. The phrase is said to have had its origin in the bonito fishing of a certain Tamanika of Fotuhaa in Haapai. He went on board a boat and had the task of bailing out. The fish bit well but the man in charge of the lines continually failed to land a catch. Tamanika vented his disgust in exclamations of, "*Isa, mala nima,*" "Ugh, bad luck from the hand." At length Tamanika was given the fisherman's post and a wonderful haul resulted. It is said that the reef called Hakau Tabu was given to Tamanika in recognition of his expertness.

228. **Mavae a pa keina:** Separation of an eaten hook, that is, a hook that attracts the fish and often gets a bite.

This is applied, for example, to a handsome man and a handsome woman who have been married, but afterwards separated. Each one of them is a hook that is very likely soon to catch another fish.

229. **Ngofua e fanga kae taumatu:** The beach is free, get the *matu*.

A beach near which lived a great chief could not be fished on at will by the common people. The Samoan *matu (Caesio pisong)* is a fish which is found inshore, and therefore cannot be caught by the common people near where a chief is living except when the lord's beach is open to the public. Such removal of restriction is indicated by the phrase; the beach is open and even the *matu* may be caught. Used generally of being permitted to do that which was prohibited.

230. **Oku kei mata ae tua niu:** The rib of the coconut leaflet is still green.

Indicates primarily a fishing net in which the leaflets of the coconut are strung on a rope. This net is used more than once; it may be used as long as the leaves remain in good condition. Applied directly to fishing it means that there is still opportunity for the sport as the net is not yet past service. Generally it means that there is still time, or opportunity, for something.

231. **Pa kuo fau:** Fish hook that has been made, that is, skillfully made by a real craftsman.

Thence generally to that which has the marks of real craftsmanship about it.

232. **Taki taha uku ene fonu:** Each one dive for his own turtle.

This is commonly used of everybody attending to his own interests. The pursuit of the turtle is a difficult sport calling for considerable experience and skill. It is a sport moreover whose fruits must be properly shared with the chiefs ashore. When the man in charge of a turtle-fishing expedition sees that he has sufficient to satisfy the appetite of etiquette he may give permission to his men for each one to try to get something for himself.

233. Tuku e feke kae jio kehe: Letting the octopus alone and looking away.

The octopus is a very highly relished dish. Moreover when estimating the skill of a fisherman in catching the denizens of the rocks more account will be taken of his success with the octopus than with any other sea creature. So this phrase indicates one who is regardless of that to which he should pay earnest attention.

234. Tulituli henga: Beginning to go for the *henga.*

The *henga* is the tuft of hibiscus fibre used as a bait in certain sorts of fishing. The phrase means primarily that the fish are nosing about the bait and the fisherman can feel that they are close; so the meaning is that the fish are close. Thence of anything that is near at hand.

235. Vale a hakau: The reef is foolish.

Indicates that a boat has gone out to sea to fish for bonito or shark but has been unsuccessful. The vicinity of certain reefs is frequently resorted to as a fishing ground.

SHELL-FISH AND SHELL FISHING

236. Filihia moe elili: Overturned with the *elili.*

The *elili* is a shell-fish whose favorite haunt is the edge of the reef where the sea breaks heavily. The shell fisher is therefore apt to be overset by the big seas when seeking the *elili*, but this will be endured for the sake of the prize.

237. Maumau e elili moe loka: The *elili* wasted by the rough sea.

The *elili* is a shell-fish whose favorite haunt is the edge of the reef where the sea breaks. If the sea is too rough it is impossible to gather it. So there may be places where there is good store of natural wealth but the difficulties are so great that man is prevented from availing himself of this plenty.

238. He oku kula leva ae unga? Is the crab red at once?

A question in this form is frequently used of emphatic negative. The crab turns red when cooked and although the change of color may take some time yet it is bound to appear. So of things that are hidden; sooner or later the truth will come to light.

239. Unga toho ngeeji: Hermit crab dragging shell.

The hermit crab, burdened as he is with the shell of some other creature, makes only slow progress when he moves. This expression is used of one who is slow in his work or movements.

240. Koe loli foki e vau: The sea-slug (*Holothuria atra*) anyway will be scraped.

This sea-slug is found in great numbers on the reefs; before it is eaten its outer bitter skin is scraped off. If those who go out on the reef for shell-fish and the like fail in finding anything else they are sure to be able to get some sea-slugs to scrape. Used of conversation which failing of topics comes round to some thread-bare subject or well-worn scandal.

241. Pulou kema: Veiled with a clam-shell.

Used to one who is ashamed to make a request. It is like saying "put a clam-shell over your face so that it cannot be seen and then beg for what you want." Also used of one who is very ready at begging things from others. He is as though he had no shame, as though his face were always shielded from observation. (Compare No. 395.)

242. Tafola vetevete afi: *Tafola* scattering fire.

The *tafola* is a kind of crab which is cooked by being thrown alive into the embers and whose death agony is marked by violent struggles which scatter the fire. The expression is used of a disobedient child who apparently makes a moral dispersal of his elders' commands analogous to the displacing of the fire by the luckless crab.

243. Takanga a pipi mo kahi: Companionship of the *pipi* and *kahi*.

The *pipi* and the *kahi* are two shell-fish which are often found together, but the *kahi* devours the *pipi*. It is like the companionship of a simpleton with a sharper who fleeces him. Baker translates the phrase: "To make a pet or comrade of one who will cause trouble or pain." (Compare No. 47.)

244. Tanu a uu: The burying of the robber crab, or the robber crab buries himself.

The robber crab (*Birgus latro*), burrows into the sand and buries himself, often for months at a time. He remains under ground so long that one might think he was dead but one day he comes again to the surface. So used of a thing that is long out of sight but at length comes again to light.

245. Tonuhia ae kaloaa ka koe vaka: The *kaloaa* is in the right but it is the boat.

The *kaloaa* is a shell-fish (*Arca scapha*?) which does not move about, unlike the boat which goes and comes at will. So if any disagreement arises between them the blame should fall not on the stationary *kaloaa* but on the boat which went to the place where the *kaloaa* lives.

246. Utu tahi moe alaala too: Carrying seawater and rummaging for the *too,* a kind of shell-fish.

Literally this indicates one who has been to the sea to bring water and while there has taken the opportunity to do a little shell fishing. It is applied to one who while ostensibly occupied about some task, or in doing some errand, has taken the opportunity presented by this job of doing some private business. An illustration of it is a person apparently very willing to go on an errand for another, but whose real reason for going is the opportunity that will be given to meet someone whom he is anxious to see.

SHIPS AND SAILING

247. Faka-fotu-la: Appearing by sail.

The appearance of the sail of a boat too far out at sea for her hull to be distinguished is not always a safe guide in estimating the size of the vessel, as little ships sometimes have big sails. This is said to have been notably the case with the old Tongan canoe called the *tongiaki.*

248. Fakahua kae paea pe: Tacking but just drifting.

A sea expression meaning a boat which is beating up against the wind but making little headway, being drifted out of her course by currents or waves. Applied to a man who is working against obstacles but whose efforts are not meeting with much success.

249. Fakato vaka a Kupolu:

We have not been able to get any explanation of this phrase. The meaning given by Baker is, "To give and take again by force." (An English and Tongan and Tongan and English Vocabulary, p. 207.) The literal meaning seems to be, "Handing over a boat of (or by) Kupolu," and probably there is connected with it a story of a boat given to the people of Upolu in Samoa, or given by them to someone else, and then taken back by the original owner.

250. Fakatou katea: Both *katea.*

The *katea* is the larger of the two canoes in the Tongan double boat. If both canoes are large and capacious so that scarcely any distinction can be made between them they might be described as both *katea.* The expression is applied in various ways, as of a well mated couple, or generally of two things which are both good and useful of their kind.

251. Foa kau tuu: Smash. I'll stand, that is, stand safely on the shore.

Used of a boat in danger near the land the crew of which determine to let her drive on shore regardless of rocks or breakers. The boat will certainly be smashed but her human occupants have a chance of life. Human life is more valuable than any boat.

252. **Hange ha fana fotu:** Like a mast that shows up.

Refers to a tall mast which stands out clearly among other masts and which appears for a long distance at sea. Used of that which is obvious. "Plain as mud in a wine glass," "Plain as the nose on your face." (Compare No. 331.)

253. **Hange ha lingi lolo ki ha tahi peaua:** Like pouring oil on a rough sea.

The Tongans have long been familiar with the effect of oil on rough water. Sometimes if no oil were at hand but coconuts were available they would chew coconut flesh and spit it out on to the rough sea. The metaphorical application is identical with the English, "Pouring oil on the troubled waters."

254. **Hao he afa kae ngoto he tofu:** Safe from the hurricane but sunk in the calm.

This picture of a boat surviving great peril but perishing in calm through the folly or carelessness of her crew is applicable in the same way as the like idea is in English.

255. **Kanakana fai ki tahi:** Eating carried out at sea.

At sea some people are sick and cannot eat. A greedy man might put off eating till at sea knowing that some of his party who would have enjoyed food ashore will have no inclination for it at sea, and that thus there will be the more left for himself.

256. **Ka ne faifai kau faka-hamahama:** If it had been that I had acted *hama* fashion.

The *hama* was the leeward boat in the double canoe, also the outrigger in the single canoe. In the double canoe the *hama* is smaller than the windward boat and is less used for passengers and cargo. Employed here to indicate a failure to act to the full extent of one's capacity. Used by one who has done his utmost and has accomplished a difficult task. If I had not done my best (I could not have done what I have done).

257. **Kataki e mama moe hopohopokia:** Eating a leak with seas coming on board.

Kataki is to eat one thing as relish to another. In this expression the seas coming over the side are the relish to the leak. To be involved in the double danger of a leak and rough sea. Generally of a double misfortune or peril.

258. **Kehe a Tonga nae folaua kae kitenoa ai a Eua:** It was Tonga to which the voyage was being made and the appearance of Eua was of no account.

When boats are making for Tongatabu the high island of Eua shows up before the mainland is seen, but although Eua appears yet it is Tongatabu to which the boat is sailing and where she finally anchors. When one is in pursuit of some object the turning up of other things is a mere incident. This seems to be confined in its application to the case of a woman who falsely supposes that visits are being paid by a man to her when in reality they are paid to another lady living in the same place. The close association into which the lover is brought with the second girl is a mere incident of his courtship of the first.

259. **Ki ama tae alomua:** "To leeward" without being the man in the bow.

When two or more men are paddling the native canoe it is the duty of the foremost to give sailing directions, typified by "*ki ama*," "towards the outrigger or leeward canoe." Anyone who was not the bow man, and yet presumed to give instructions to the crew, would fall under the rebuke of this expression.

260. **Kite faka-fonua mounga:** In sight like mountainous country.

A mountain appears to the ship far out at sea but it is a long time before it is reached. A thing that appears but it is in reality far off and takes long to reach.

261. **Koe mata mama:** The chief leak.

In a boat which has filled and sunk there may be little leaks which in themselves would not have caused the disaster, but there is one big leak which is the real cause of the trouble. Generally of that which has been the fundamental reason of catastrophe.

262. **Laukau he tauala oe jiana kehe:** To be proud of another chap's coming up to the wind.

A metaphor from navigation, *tauala* being to luff up into the wind. Employed of the useless pride of one man in the achievements of another with which he himself has had nothing to do.

263. **Limua ae vaka:** The boat is covered with seaweed; that is, the boat has been neglected and left in the sea without use or without being hauled up for cleaning.

Applied to that which is suffering from long neglect and disuse, in the same way as we say in English that a thing is rusty.

264. **Lujia ki taulanga:** Weather-beaten to harbor.

The vessel although storm-tossed and battered has at length made port safely.

265. Mamao a folau: Distant on a voyage.

This seems a fair representation of the literal meaning though it may be translated slightly differently. This rendering, however, well indicates the real meaning and use of the expression, which is that the one spoken of is at a distance but will return. He is away on a trip, not to stay, and in due course the time will come for his return.

266. Mamao a hikuhiku jila: The distance of the tip of the yard, or the tip of the yard is distant.

This refers to that which is now at a distance but which later will be brought near. Just as in the boat the tip of the yard is far out of reach and hanging over the sea when the sail is set, but later on the sail will be taken in and the formerly inaccessible end of the yard will be brought within easy reach.

267. Mata liu ae fine heke: The strange woman (that is, one without part or lot in the matter) looking at a boat's hold.

This is said to be referable mainly to important fishing, such as shark fishing, and to indicate women who go to the shore to see a boat with which they have no concern discharge her catch. The women who are connected with the boat would say in effect by this phrase, "Let these women look; that is as much as they will get out of it. Ours it is to share in the distribution of the spoil." It is referred to the fascination and interest which women unaccustomed to the sight of a boat unloading her cargo would find in the spectacle. They would wish to return again and again and see more of it. To this line of thought seems to belong its application to a woman enamored of a handsome man (*manaia*). She would never tire of going to look at him. The first idea seems to be present also. Let her look at the man; he will be another's prize. Baker, however, gives what is apparently an opposite meaning, "To be enamored of strange women." Its most common application, at any rate at the present day, would seem to be to women looking at the treasures being unloaded from a boat in which they have no concern.

It is stated also that this expression has reference to the ceremony following the launching of a new boat, the *hopoki,* literally the getting on board. Before this ceremony the boat could not be entered by women. The ceremony might be performed by men but was usually done by women; the most proper person being the chiefliest woman amongst the people to whom the boat belonged. In this connection also the idea would be of the distinction between the "other" women who had no part nor lot in the boat, and those who were intimately connected with her. (Compare No. 400.)

268. Mata vaka piki vaka: Seeing boat, sticking to boat.

People are welcome to go and see other people's boats, but they must not go on board without permission or otherwise take the sort of liberties with her which one may take with his own property. A caution against meddlesomeness.

269. **Matangi lelei to ki la mahaehae:** Good wind falling in torn sail.

This indicates good opportunities put into the hands of those incapable of turning them to advantage.

270. **Ongo fakaevaha:** News like that from the open sea; more literally from "between."

The stretch of sea separating one island from another is commonly spoken as "the between." One might employ the same mode of speech for being out at sea.

News from the open sea is the unreliable reports that travellers bring; yarns concocted while out at sea at a distance from good sources of information. It may be applied generally to stories that are not sufficiently founded on fact.

271. **Ohooho a liu lahi:** A large hold (of a boat) unfilled.

A large vessel of great carrying capacity may be unfilled and yet contain a very large cargo, while a small boat will be filled to overflowing by a much smaller load. Small people, and small receptacles, may appear to be carrying very large loads but in reality their burdens are much less than those easily borne by persons and vessels of greater capacity.

272. **Pata i la tuu** or **Pata i la kuo tuu:** Rejoicing in sail that is standing.

Used of a high degree of satisfaction, such as that which the sailor feels when the breeze is fair, the sail well filled, and the boat making good way.

273. **Peau tupu-koso:** Wave rising (at the) *koso.*

The *koso* is an ornamental carving at the bow and at the stern of the canoe. The expression refers to a wave that rises right under the bow or stern of the boat and gives the steersman very little time or opportunity to ride it properly. Hence of danger or calamity which comes suddenly upon one giving him but little time either to avoid it or take measures to meet it.

274. **Pelu la kei mamao:** Reef sail still at a distance, that is, while the storm is still at a distance.

To have everything snug and prepared in ample time to meet a threatened danger.

275. **Pili e tauhala:** Near the rope, or the rope is near.

The *tauhala* is a rope that was trailed astern in rough weather to afford succor to anyone who happened to be washed overboard. This expression is said to indicate primarily one who has been washed overboard and has nearly missed the saving rope; has nearly let it pass him before he has succeeded in seizing it. Generally of one who has had a narrow escape. To be exposed to danger (Baker).

276. **Po fakafitaa uli:** Night persisting through difficulties (with) steering.

Literally applied to a boat making her way through storm and darkness; the steering of the vessel is rendered extremely difficult but the sailor sticks bravely to his task, and in spite of difficulty and peril, the vessel holds on her course. Applied generally to hard, arduous tasks, especially with the idea of going through with them, refusing to be daunted.

277. **Punufuu hage ha fuu vaka Vavau:** Obstructing like a great Vavau boat.

It is said that a boat coming from Vavau to Haapai was unlucky enough to run on one of the reefs there blocking the opening which was the entrance to the anchorage at that spot. The expression is applied, for example, to one who enters a room and plants himself down in front of the door.

278. **Ta e lango kei mamao:** Cut the slips still at a distance, that is, when the occasion for its use is still at a distance.

Lango, rendered here by slips, is a timber for raising anything on like the timbers on which a boat is pulled up out of the water or launched. The slips on which a boat is launched is probably the timber specifically indicated in this expression. The meaning is to have the preparations for launching all made beforehand so as not to waste time about it when the day comes to put the vessel into the water. Generally, to prepare well ahead for anything.

279. **Takanga a tongiaki:** A *tongiaki* in company.

The *tongiaki* is one of the old sailing canoes of Tonga, not so large or seaworthy as the more familiar *kalia.* A couple of these canoes might sail along in company in fair weather but if a storm sprang up neither could rely much on the other for assistance. They had neither the size nor the qualities to make them very serviceable companions in distress; in fact each would be hard enough put to it to secure her own safety. So used of fair—weather friends.

280. **Takanga enau fohe:** Mates (at) their oar; perhaps, their oars are mates.

The Tongan sailing canoes had two, sometimes three, steering oars. In calm weather one man apiece sufficed for these oars but in storm more would be required. This phrase indicates that the men at the oars, whether one at each or more, are well matched in skill and so the steering is done well and harmoniously. Men who are all capable workmen laboring together and carrying out their task ably and agreeably.

281. Tangata e taha oe vaka: One man in the boat.

Only one able-bodied man on the job; all the rest are women and children or old men. Everything on the shoulders of this one man.

282. Tata tuli vaka: Beating (of the native drum) chasing boat.

It was common for the sailing canoes to have a drum on board with which arrivals and departures were announced. When two boats were racing and one was on the point of overtaking the other the drum on the overtaking boat was beaten in a particular way. (There were many different ways of beating the drums in accordance with the purpose for which they were sounded.) This beat of approaching victory naturally spurred the crew to their highest efforts. So of the exultant energy which is put into a task which is on the point of being carried through to a successful conclusion.

283. Ta tefito mei ama: Strike root from the leeward canoe.

This expression, which means to kill a man or woman for food, does not seem to have passed into proverbial use. Roots are the stand-by in times of famine. In the leeward canoe were mostly found the passengers, largely women, who were not occupied in the working of the vessel. To strike a root from the leeward canoe, therefore, was to replenish the larder by a foray amongst the passengers.

The phrase occurs in the tale of the voyage to Tonga from Fiji of Tui Motuliki, the son of Sinailele and the bones of the two Maui, Atalanga and Kijikiji, accompanied by the chief of Bau, Nokelevu. Each day during the voyage when it was reported to Nokelevu that the oven was hot he would order his people to strike a root from the leeward canoe and a man would thereupon be slain and eaten.

284. Tefua a vaka Lautala: Gathering together of the boats of Lautala.

This proverb does not seem to be any longer in use. Baker renders it: "Clever hands gathered together at any work," in accordance with a present-day explanation that it indicates things not large but valuable and strong.

Lautala is the name of an anchorage or beach on the island of Haano in the Haapai group. If this is the Lautala referred to it would seem to have been a place noted for boat-building or seamanship. An informant who has Fijian blood in him referred the expression to the island of Lautala near Suva in Fiji. This is but a small island, and he explained the phrase as probably meaning that when the boats of Lautala are gathered together their utmost might is a thing of no account to the powerful chiefs in the neighboring localities. There does not seem much support for this interpretation, but the reference to the Fijian islet may be correct, especially if its people were famed as boat-builders, a matter about which we have no information. Tongans frequently get boats from Fiji. For the meaning "small but valuable" compare Nos. 85 and 203.

285. Toki tau ae vaka e:

It is difficult to render this proverb literally. As nearly as possible it would be "The boat has but now reached land," but more in accord with the nuance of the Tongan phrase would be an appreciative "My word, the boat has made land at last. It is illustrated by a boat which has struck heavy weather and been forced to run for shelter to some port other than that for which she is making. At last, however, she is able to make the right harbor; the passengers and crew can go ashore for now they have really made the land and are not as before merely seeking a temporary shelter where they do not wish to be.

286. Tuai mei uta: Slow from the land.

The idea is that of delay in a place where one is comfortably placed and has occupation. One may keep a boat waiting while he is seeing to his affairs on shore, but there is more sense in spending time in a place where one has resources at his disposal than in wasting it in the condition of helplessness in which men find themselves at sea.

287. Tuku mo fai la: Letting down and making sail.

A busy port where boats are constantly coming and going. One boat no sooner comes to an anchorage and lowers her sail than another leaves her moorings and hoists her sail. Refers to that which is always busy and on the move. No sooner is one job finished than another is started, like a boat which accomplishes one voyage only to shortly commence another trip.

288. Tuu e la mo poupou: The sail standing with support.

In the Tongan sailing canoe a support was used to strengthen the mast. The sense of the phrase is to take every precaution; not only hoist your sail but see to it that it stands as firmly as possible. Applied generally with this meaning of doing everything to secure stability, success, safety.

289. Uta lea i vaka: Land speaking in boat.

A landsman offering advice or giving orders in a boat.

290. Vaka ki ua: (Making a) boat of neck or shoulders.

The boat is the means of carrying burdens but inland a boat is of no use, so that the neck or shoulders have to be used for this purpose.

291. Vakavaka mua: First boat.

The picture is that of a fast-sailing boat which out-distances other boats and reaches harbor first. Applied to one who is ever ready to speak. Before anyone else can say anything he thrusts in his advice or opinion.

CLIMATE AND SEASONS

292. Aho faka-ua: Double day.

Used of those times of the month when the moon is so bright that, even after the sun has set, there is sufficient light to perform outside tasks, go journeys, and the like.

293. Mokomoko aho: Coolness (of) day.

This indicates the coolness which precedes the dawn, and is thus a harbinger of day. It is used to encourage those who are getting towards the end of a task. Persevere, be of good heart, we are close to daylight, we have nearly finished.

294. To lelei ae ataata: The dusk falling well, "The sun setting in a clear sky" (Baker).

A sign of fair weather; has the same applications as similar expressions in English.

295. Afa ka e tofu: Hurricane but there will be calm.

An exhortation to people in hardship not to make their present difficulties an excuse for neglecting the kindnesses which men owe to each other. The present adversity may make it difficult to do a kindness to a neighbor, but prosperity will return and then the neglected opportunities of showing good-will will be remembered with shame.

296. Fakatofutofu kae hiko: Calm but about to blow; apparently well but again falling upon evil.

The expression originates with the hurricane. As the wind veers there is a calm; after this interval the wind blows again from another quarter with as great violence as before. The word *hiko* translated above as "blow" has perhaps the signification of moving on to another quarter. In the game of *lafo* this word is used of a disc which passes another and lies nearer to the scoring-line.

297. Hange ho aho tafitonga: Like a clear bright day (literally day swept by the south wind).

Applied to persons of open, serene countenance.

298. Matafi e tonga ho finangalo: May the south wind sweep your mind; may your mind be serene and unruffled.

The translation given here is probably literally correct but *tafitonga*, which seems literally to mean "swept by the south wind," is felt and written as a single word meaning "clear, serene," and is constantly used of fine weather, and figuratively of the mind.

299. Hange ha aho tuutuu taufa: Like a day of intermittent gale.

A day that is neither consistently fine nor uninterruptedly stormy. Applied to persons and things which show a mingling of various characteristics.

300. Hiko hiko puku: Blow, blow short.

Refers primarily to the wind blowing in short squalls following quickly one another. Used of things good or bad following quickly one after another but none of them enduring long. The same expression is also used, for example, for the rattling of the lid on a pot of boiling water.

301. Kai tae tala: Eating without telling.

Apparently this indicates primarily one who quietly takes food and eats it without inviting anyone to share it with him, or perhaps one who takes and eats food that belongs to another without saying anything to the owner. The expression is used now only of a wind that comes up suddenly without warning, although in this sense, of course, it is capable of a wide range of metaphorical employment.

302. Lau matangi fai i fale: Reckoning wind done in house.

Statements made by those who have not taken the measures necessary to ensure that their opinion is worth hearing.

303. Tokelau i fale: North in house.

Used of one who sitting inside a house talks about the wind, that it is north or south, without going outside to see how it actually is. So used of the man who freely gives his opinion about matters whose true state he has not the means to ascertain.

304. Toka mono agai: Prepared with (for ?) its opposite.

A wind which blows in one direction but is certain to go around to another quarter, as do the strong gales that sometimes blow in Tonga during the summer months. Generally of things and circumstances that are bound to shift and be of a character opposite to that which they were at first.

305. Hala pe Vai ka ko Vai: The rain has missed but there will be rain.

Vai-mua (Earlier rain, or water) and *Vai-mui* (Later rain, or water) are the names of two moons in the Tongan calendar, corresponding roughly to February and March. If the rain expected in the former of these two wet months fails to appear there is still the later wet month to look forward to. It is a counsel of courage, bidding us not lose heart immediately on the failure of one expected opportunity.

306. Tanaki kai fai ki Vai: Collecting food for *Vai*, the rainy months, about February or January and March, when the native food supply is low.

This is an expression of careless indifference, almost of reproof, to deter one who desires to save food for another time. Why save? Let the lean months look after themselves.

307. Ka ai ha ofa pea tali ki Uluenga: If there is any kindness (to do) then wait till Uluenga.

Uluenga is the name of one of the Tongan divisions of the year, about October or November, when the food supply is scanty. The idea, therefore, is that anyone who wishes to do kind acts had better choose a time when they will be really useful.

308. Ngingi uha: Sounding (of) rain.

This indicates the sound of the mallets used for beating out the native cloth, or the sound of the native drum (*lali*) when there is rain about. The note of the drum or *tappa* mallets is then a sign of rain. Proverbially applied to the signs that something is about to happen. (See No. 564.)

309. Uha kei lelei: Rain still good.

Rain falling at a suitable interval after the last previous downfall, as distinguished especially from rain which falls after so long a period of dry weather that many plants have died and are unable to profit by the downpour when it does come. Generally of actions and circumstances of all sorts that occur at appropriate times and are therefore able to achieve the maximum of good.

SEA AND COAST

310. Anu tahi: Swimming (floating, wading) in the sea.

Used of one in difficulties, exactly as we say, "one has got into deep water."

311. Auhia kae kisu atu pe: Obstructed by the current but spitting on.

The picture is that of a swimmer striving against the current with the water breaking in his face and getting in his mouth; but who keeps squirting or spitting the water from his mouth and battles bravely on. Applied to one who goes indomitably on his way in spite of the difficulties which beset him.

312. Fai tahi: Sea doings, that is, unusual behavior, sometimes deceitful conduct.

The gods of the sea had characteristics different from those of the land; the conduct of people at sea is not the same as their behavior ashore. It is hard to say what special differences, if any, exist between longshore and sea-going habits and particularly why the idea of craftiness should be associated with this expression. Broadly it appears to mean things that are not done ashore.

313. Fakaita fai ki tahi: Anger bestowed on sea; "to be revenged on another by punishing oneself." (Baker.)

The story is that a party of brothers prepared food, yam with rats. When the food was divided one of the brothers, apparently the youngest, was dissatisfied with his share and in his chagrin jumped over a cliff into the sea. These brothers were chiefs, each with his own followers, and the angry man's followers went with their master over the cliff. Among them was a Samoan. The party were turned into porpoises, and the tattooing on the Samoan's body is the origin of the marking on the belly of the porpoise.

314. Feofaaki a kakau: Mutual affection of swimmers.

Kindly feelings for each other felt by those who have very little opportunity of translating their sentiments into actions, just as men swimming away from a wrecked boat can do very little for each other however much they may desire to.

315. Ha ha mo lofia: Appearing, appearing and awash.

Used of that which shows up and disappears at intervals, like an object floating in the sea, which is visible for an instant and then is hidden from sight by the waves.

316. Hange ha pa utu: Like a steep cliff.

Used of that which stands firm and unshaken no matter what storms of trial beat against it. The picture is that of a great cliff unmoved by the dashing waves.

317. Hange ha tahi hua: Like an incoming tide.

A resistless thing.

318. Matemate a liku: The *liku* still.

The *liku* is the weather side of the island, usually protected by a broad shelf of rock, and always presenting a rock-bound inhospitable coast. Even when the tide is out and the sea smooth, leaving the shelf of reef dry and bare, one cannot altogether trust appearances for a sudden wave may come up and perhaps overwhelm those who are exposed in dangerous places on the rocks. Appearances that cannot be trusted.

319. Laku maka fai ki tahi (or **moana**)**:** Casting stones into the sea (or ocean).

A type of a useless labor; the stones are lost but the sea is not dammed up.

320. Likuliku mo ao: Windward and leeward.

The sea breaks heavily on the weather side but there is calm on the leeward side. This mixture of rough and calm is used proverbially of one whose character displays like inconsistencies; at one time he seems an honest man, and at another a liar; at one time kindly, and at another harsh.

321. Limu tuu i au: Seaweed standing in current.

That which is unstable, like seaweed constantly moved by the water.

322. **Mamaha ae tahi he kuo tuunga kiu:** The tide is low for the plover (*Charadrius fulvus*) can stand.

There are a number of phrases for different stages of the outgoing and incoming tide. *Tuunga kiu,* standing for the plover, indicates the time when the sea has receded so far as to leave isolated rocks projecting here and there on the reef, thus affording standing places for the plover. Proverbially used of that which is nearly finished, of which signs of approaching completion are appearing here and there.

323. **Nofo i lelenga:** Living at cliff; being at the top of the cliff.

Lelenga is the name given to a very high bare cliff in Eua, with a sheer drop into the sea. It is possibly, in this connection at all events, a proper name, but Baker gives it as a common noun meaning jeopardy. The expression *nofo i lelenga* has been explained as referring directly to the cliff in Eua, a fall from which would be certain death, and where, owing to the nature of the coast, the chances of recovering the body would be slight. Used generally of being in danger, uncertainty of life. Nowadays frequently heard in Christian worship in reference to the uncertainties of life.

324. **Paepae kae auhia:** Mounded up but washed away.

Perhaps in the first instance refers to the leaves put in the sea to bleach in preparation for mat making. These leaves are anchored by stones put on them. If not this the obvious meaning is still that of something which is piled up but yet washed away by the currents. It is applied to that which one tries to do, to put through, to make fast, but cannot.

325. **Ta ki ao ta ki tua:** Having regard to front, having regard to back.

Ta ki liku ta ki ao: Having regard to weather side (of an island), having regard to lee side.

Ta ki liku ta ki fanga: Having regard to weather (rocky) side, having regard to beach.

Ta ki tahi ta ki uta: Having regard to sea, having regard to land.

These expressions have the same meaning. In reference to persons they denote all-round excellence; used of place they mean everywhere.

NATURAL FEATURES OF LAND

326. **Fuli ki vanu:** Overturned into chasm.

Such a thing will not appear again; it is finished and done with. So of a thing that is finished, whose usefulness is quite over.

327. **Ka kele a matavai e kele mo muivai:** If the source is muddy the lower waters will also be muddy.

This has its obvious application to things spoiled throughout by corruption at the fountain-head. Although pure Tongan in form and vo cabulary this phrase seems out of place in Tonga, a country almost entirely without running water.

328. **Tafe jino i vai:** Perhaps flowing as a body of water.

Pratt (Grammar and Dictionary of the Samoan language), translates *tafetinoivai:* "to flow in the river bed." It is used in Tongan of that which is manifestly good and may indicate a distinct, clear-flowing, volume ot water in contradistinction to scattered streamlets. Except for a few tiny rivulets in Eua the Tongan group is without surface flowing water, and so such an expression would seem to have originated in Eua, or, perhaps more probably, to have been brought from Samoa.

329. **Ta jino-i-vai:** Cutting out body of water.

Water making for itself a channel, and becoming a manifest body of water. Like the preceding, this expression is applied to that which is clean, unsullied, as well as to that which is manifest.

330. **Tuutuu mounga:** Standing (on) mountain.

Applied to one who is out of reach by reason of rank or the protection of those of high rank.

GEOGRAPHIC LOCATIONS

TONGATABU AND EUA

[Tongatabu the chief island of the group, and the seat of Government. It is one of the most southerly of the Tongan Islands. On its southeast side is the high and beautiful island of Eua, separated from Tongatabu by a narrow but very deep strait.]

331. **Hange ko Manaki:** Like Manaki.

Manaki is a high towering rock in the island of Eua, and is a very prominent feature in the landscape. Used of that which is obvious. (Compare No. 252.)

332. **Hange koe Matafota:** Like Matafota.

Matafota is a place in the sea between Eua and Tongatabu, which has passed into a proverb for its roughness. (See No. 342.)

333. **Koena pe he Tuatoi:** Tuatoi is just over there.

Tuatoi is a place in Eua at a considerable distance from Ohonua, the chief centre of population. Used in an ironic or deceptive way to one who asks how far a place is away. The one inquired of may just point in an offhand way and say, "Oh, Tuatoi is just over there," but when the one who asked comes to walk the distance he will find that he has a long way to go.

334. Nukualofa fakahekeheke: Flattering Nukualofa.

The name Nukualofa, applied today to the large village which is the capital of the modern Kingdom of Tonga, had formerly a much more restricted application. Speaking generally, however, it is said that this part has been called successively by the names Maufanga, Navua, Nukualefa, and Nukualofa. Of the last two, Nuku-alefa means Hungry-place, and Nuku-alofa, Kindly-place. Flattering Nukualofa is used derisively with the imputation that the expression of "Kindly-place" is mere flattery used to procure food for Hungry-place.

335. Taka Tongatapu tae i Eua: Going about in Tongatabu without being in Eua.

The island of Eua although close to Tongatabu is inconveniently situated for coming and going with the prevailing winds; the trip one way is frequently easy but sometimes several days elapse before a sailing boat can make the return passage. Consequently comparatively few people visit Eua. One may live for years in Tongatabu or a stranger may go through Tongatabu from end to end and yet not include Eua in his itinerary. (See Nos. 350 and 352.)

336. Toka i Maananga: Lying (beforehand) in Maananga.

Maananga is the name of the home of the chief Loau who plays so great a part in Tongan legend. He was a seer who resting quietly at home was able to see all that was going on elsewhere, or at least a great deal of it. People might purpose to carry out a project and set to work on it, but it was all known to the chief in Maananga, the whole thing lay exposed to view in Maananga. This expression, written as one word, is commonly used of omniscience in Christian worship.

337. Tonga mounga ki he loto: Tonga's mountain is in its heart.

This is said to be the reply of the Tongatabu people to the people of Haapai and Vavau, when taunted with having no mountain in their island. The phrase has been very happily adopted by the late Rev. Dr. Moulton as the motto of the Tubou College, of which he was the founder. Dr. Moulton has of course applied its brave language to the whole of the Tongan group, inclusive of Haapai and Vavau. If this account of the origin of the expression be correct it bears interesting testimony to the isolation of Eua from Tongatabu. Eua is not as high as Tofua or Kao, the two mountainous islands of Haapai, but it is certainly very high land in Tonga and is much closer to Tongatabu than Tofua and Kao are to the main part of the Haapai group, which is in general very low. Moreover, the population of Eua has probably always been greater than that of Tofua and Kao. The people of Eua, although only a few hours' sail under favorable conditions from Tongatabu seem in general to have lived a life of their own, though by no means one always of peaceful monotony.

338. Uakai pea alu ki Fuaamotu: Hungry, then go to Fuaamotu.

Fuaamotu is a village in the eastern part of Tongatabu, a place that to a great number of the inhabitants of Tongatabu seems and actually is at a considerable distance from their own homes. It is moreover a high chiefly village; and therefore a likely place to obtain food. There is a double reference in this phrase; first, that one is so hungry that he is willing to go a long way to obtain food; second, that in going to Fuaamotu he is going to a good place to get it.

HAAPAI

[Haapai is the central portion of the Tongan group, lying almost midway between Tongatabu to the south and Vavau to the north. It is a widely scattered archipelago, consisting almost entirely of low coral islands.]

339. **Afa kai fai ki Haa-Ngana:** A great talk about food after the Haa-Ngana way.

Haa-Ngana, the tribe of Ngana, is found in three small islands in the Haapai group. What might be reckoned a great thing in these small islands is not necessarily of such dimensions as to appear worthy of special comment to the inhabitant of a larger place. Much ado about nothing.

340. **E seea ae namu Nomuka:** Nomuka mosquitoes will be driven away.

The island of Nomuka, one of the southernmost of the Haapai group, is deservedly famous for its mosquitoes. The expression is used for that which is very difficult. It is easier to keep the mosquitoes off oneself in Nomuka than to do so-and-so. (Compare Nos. 370, 358 and 133.)

341. **Foa ulu efu:** Foa dusty head.

This is an abusive epithet applied to the people of Foa in Haapai. It makes a Foa man angry and does not seem applicable to any peculiarity discoverable today in the people or their island, which is large and very fertile. A story is told which refers the origin of the expression to a combat between two chiefs of Foa. One hit the other on the head with his club and made a cloud of dust fly out. It is also said the yams in Foa have large heads with plenty of room for the dirt to lodge when they are dug up; but this strikes one as being rather the finding of fresh cases to which to apply the abuse than the explanation of its origin.

342. **Hange ko Fakatoutoa:** Like Fakatoutoa.

Fakatoutoa is a place in the sea near Nomuka, in the Haapai Group, where rough water is frequently encountered. Used proverbially of rough seas. (See No. 332.)

343. **Hilinga mo Tolu koe motu tokanoa:** It becomes Tolu, an island that lies right out of the way.

Tolu is a small group of islets lying at a considerable distance from any other portion of the Tonga Islands and is, moreover, rather inaccessible and out of the usual track of boats. The expression as it stands, is elliptical, but would be readily intelligible in a context. It means that a backwoods, out of the way place like Tolu had better not interfere with the affairs of other places. It is a way of telling anyone to mind his own business.

344. Nae tai ae vaka Mounga-one koe ikai hano eiki: The Mounga-one boat was smitten because it had no chief.

The story is that a party of men sailed from Mounga-one in Haapai to some part of Fiji. On landing they cooked themselves some chestnuts (*Inocarpis edulis*), which were passed around and eaten in a most informal manner. While this was going forward a party of Fijians appeared, and feeling sure from the haphazard, go-as-you-please way in which the Tongans were taking their food that no chief was present they fell on them and slew them. This incident is jocularly referred to by one of a working party who is lazy, or who perhaps really deserves a rest, and wants to sit down. He sits down with the remark that the Mounga-one boat was cut out because there was no chief there, his meaning being that he will sit down and play the chief for the party he is with.

345. Oku ikai ha vaka e mate i tahi ka e mole ai a Haano: There is not a boat lost at sea but a Haano man perishes there.

The people of the island of Haano in Haapai have the reputation of being such incorrigible wanderers that a boat cannot be wrecked without there being someone from this island among the drowned. Wherever you find a boat you are sure to find at least one Haano man on board.

346. Kama e tevolo i Kao, Kae tuku e tevolo aau: Reaching out to, attending to, the devil in Kao, but not noticing your own devil.

In its present form this appears to be modern, and it is impossible to say whether there was an older form in which the word *tevolo* is replaced by something more certainly ancient and genuinely Tongan. The second line is sometimes rendered, *Kae tuku ae tevolo ho ao*, But not noticing the devil in your presence. The expression apparently originated in Haapai, where the island peak of Kao is situated. It is used here as the type of that which is distant; concerned over evils at a distance but regardless of the evils which are close at hand. (Compare Nos. 422 and 423.)

347. Tekefili hange ko Kao: Lying manifest like Kao.

The high conical island of Kao in Haapai is the most striking feature in the seascape for very many miles around. "As plain as Kao" means much the same as "As plain as a pike-staff," but is a much more striking and forcible expression.

348. Koe mamao he ko Aka: Distant, for 'tis Aka.

Aka is the name of a reef near the islands of Tofua and Kao, the two volcanic mountains of the Haapai group. To reach this reef involves a long sail from the islands that were the main centers of population, bu canoes used to go there for fishing. The expression is used generally of a long voyage to reach a reef.

349. **Manako maka fai ki Tofua:** Wishing for rock in Tofua.

Volcanic stones and pebbles from Tofua are highly valued for several purposes, but Tofua is far from most of the inhabited islands, the anchorage is bad, and contrary winds are frequently met with, especially in returning. Wishing for stones from Tofua, therefore, is to desire something that is worth having but difficult to obtain.

350. **Taka Haapai tae i Tofua:** Going about Haapai without being in Tofua.

The meaning of this is similar to that of No. 335, the volcanic mountain of Tofua being as inconveniently situated with respect to the main portion of the Haapai group as Eua is with respect to Tongatabu. (See also No. 352.)

VAVAU AND NIUA FOOU

[Vavau is the most northerly of the Tonga Islands with the exception of the outlying islands of Niua Tobutabu and Niua Foou. Vavau is high and picturesque and possesses an exceedingly fine harbor. Niua Foou is about midway between Vavau and Samoa.]

351. **Kai pe e Ngaunoho ae fua o enau gaue kovi:** Ngaunoho is merely eating the fruit of its ill deed.

As a proverb this is one of the many expressions found scattered throughout the world which warn erring mortals that they must reap as they sow. Ngaunoho is a village in Vavau, and is said to have been once a flourishing place but to have fallen from its old prosperity through having offended its chief. Its present decrepitude is the fruit that it has to bite on.

352. **Taka Haafuluhao tae i Poujini:** Going about in Haafuluhao without being in Poujini.

Haafuluhao is a common name for Vavau, the northern part of the Tonga Islands. Poujini is a small islet near Haalaufuli in Vavau which is not often visited. This is similar to Nos. 335 and 350.

353. **Tala kei i Kapa:** Tell still in Kapa.

Kapa is an island in Vavau, lying close to the island of Mala. The route from Kapa to the mainland lies through Mala, where once dwelt a formidable cannibal man or demi-god. Warnings should be given or preparations made in Kapa before passing on to Mala, where one was in deadly peril. Used generally of taking time by the forelock, making all preparations to meet danger before one is actually involved in it.

354. Faka-Niuniua-foou: Niua Foou fashion.

Tongans generally do not ask a stranger his name directly but ask a third person who knows him, whereas the people of Niua Foou make no scruple of a point blank inquiry. Hence to ask anybody his name directly is to act in the Niua Foou way. There is a special application to kava drinking. The *matabule* who is directing the brewing and distribution of the drink may not know the names of all present. A very common proceeding in such as case is to quietly inquire of one sitting near who so-and-so is; but he may say "We'll do Niua Foou way," and then without further invitation the strangers will each tell their names, or someone who knows them will name them out.

OTHER LOCALITIES

355. Faji pe jila tuku ki Manono: Boom broken—leave it to Manono, or boom broken, impute it to Manono.

Either of these expressions is a literal translation of the words. The origin of the phrase is obscure, but it is applied in two ways in accordance with the two translations given: 1. When a thing is broken, leave it to such a one, or to certain people who are skilled craftsmen and will mend it; 2. When a thing is broken, impute the blame for the mishap to so-and-so.

356. Hange ha tama Polataane: Like a British man.

This indicates one of martial aspect. Presumably the Tongans in the days of their first contact with European seamen grew accustomed to the sight of fully armed landing parties.

357. Koe aho ni ape e tuku ki Uvea: Today apparently is to be left to Uvea.

When the Tui Tonga had a big piece of work on hand, as for example building or repairing his boat, the *Akiheuho,* the duty of feeding the carpenters was apportioned among the various districts in rotation, even as far as Uvea. The Uveans lived a long way off, and on their day the workmen frequently went hungry. So on any day when it was not clear whether any food would be forthcoming for them or not the carpenters were wont to say, "H'm, looks as though today were being left to Uvea." Used generally of uncertainty whether a desired event will happen or not.

358. Ko Vaihi e: That's Hawaii.

Indicates that which is far off and impossible. Much as English people speak of asking for the moon. "Did you get such a thing?" "That's Hawaii," that is, I have as much chance of getting that as I have of getting Hawaii. We are unable to say with certainty, but think it probable that this name Vaihi is no old recollection preserved in Tongan tradition, but a recent innovation since the visits of European vessels. A variation of this is *Ko Vaihi mataloaloa,* that is, yellow-eyed, or yellow, Hawaii; but we do not know the reason of the epithet.

DISTINGUISHED PERSONS

359. Halaia Moli tuku kia Loli: Moli guilty—attribute it to Loli.

We have no information about Moli and Loli, but the phrase means that the blame of one man's wrong-doing is thrown onto another.

360. Hola pe te ke hao ki he fale o Vave: Flee that you may be safe to the house of Vave.

Vave was a great warrior who lived in Haavakaotua, a district near Nukualofa. So great was his might and so secure were those whom he protected that to flee to him for safety passed into a proverb.

361. Tekei a Lei hono fuu mei: Pushing Lei from his bread-fruit tree.

We have not been able to get any story relative to Lei or his bread-fruit tree, but the expression means to deprive anyone of what rightfully belongs to him.

362. Vikia vikia a Apolosi, Pea kuo te viku pongipongi: Apollos is praised, praised, and I am wet in the morning.

This is modern, since the introduction of Christianity. Apollos was a Tongan native clergyman held in high repute. On one occasion he was sailing in a boat with a silly man named Pane whom during the course of the voyage he pushed into the sea. Pane sank, and as he came up vented his disgust at the cleric's treatment in the above rather cryptic utterance. The force of "in the morning" seems to be either that the outrage was perpetrated early in the day, or early in the voyage, or perhaps that this was Pane's first acquaintance with the reverend gentleman, and so "right away," "first go off." "Here's a nice sort of chap for you; everybody praises him, but all I've ever got out of him is a jolly good ducking."

LEGENDARY DEITIES

363. Alu hifo ki takele o Maui: Go down to Maui's foundation, that is, to the depths of the earth.

In the distribution to the gods of residences the Underworld was assigned to Maui.

364. Jika a Maui: Darting of Maui.

Used of a long throw in the game of *jika.* Baker renders the phrase, "columns of smoke," which seems to liken a column of smoke rising straight and high into the air to the great cast which Maui might be expected to make in the form of *jika* in which the object was to throw as high as possible; but since the Maui lived in the Underworld it may be that the column of smoke is likened to a cast of these redoubtable deities from their subterranean home into the upper air.

365. Tamajii tali kelo: Tiresome child, especially of one who talks insistently of what he can do, or is going to do, but does not do it.

The literal meaning is rather obscure, but appears as "child receiving, or stopping, catching, brown," which is not the most intelligible of phrases. Tongan tradition assigns the origin of the expression to Maui Atalanga, the father of Maui Kijikiji; during the time when the two Maui were living in Vavau. At least two accounts are extant of the circumstances in which the phrase was first used, but they vary only in details. Tradition is agreed that the Maui were living in the neighborhood of Haalaufuli and Taanea. In the one account they went to slay a huge man-eating rat. They found the beast sitting in the mouth of his hole. The rat rushed at them, but they struck it and it fled for shelter to its nest. Then the question arose between the Maui of a plan of campaign. Each wished the other to dig the rat out while he himself waited to receive it as it ran out. At length the elder gave in to the importunity of his son, impatiently exclaiming as he did so "*Ae tamajii tali kelo,*" perhaps, "A fine sort of boy to receive this brown beast." Young Kijikiji, however, was as good as his vaunt and seized and strangled the rat as he ran from his lair. The other account says that the two Maui went to catch a big brown pig and the dispute was as to who was to pelt the pig and who to catch him as he ran in his direction. As before the elder Maui exclaimed "*Ae tamajii tali kelo (ni),*" "A fine sort of boy to catch (or receive) this brown creature," or, "A boy to catch this brown creature." It may be noticed that in Fijian there is a word *ng-gelo* meaning lame (Hazelwood, Fijian and English Dictionary, translates *qelo* as crooked-footed, soles turned up). If this word existed in Tongan it would have the form *kelo*. For the elder Maui to exclaim angrily to his son "Boy fit to catch a lame man, or creature," seems more in line with the abusive language of the Tongans, as of other peoples, than the explanations noted above; but, however attractive this may be, it cannot be adopted in the absence of positive evidence that *kelo* in the sense of lame has been used in Tongan.

366. Tamajii ukei kia Maui: A boy challenging Maui, the legendary divine hero.

This refers to one who has the assurance to challenge another stronger than himself. It is said to owe its origin to the impudent violence of the younger Maui, Maui Kijikiji, to his father Maui Atalanga, as a result of which the elder felled the younger with a spade. In Tongan legend the exploits of Maui Kijikiji quickly outrivalled those of his father Atalanga and to assign this phrase to the encounter between the two Maui may not seem therefore altogether appropriate. In any case the meaning is apparent.

367. Tavatava i Manuka: The literal meaning seems to be unknown in Tonga, but the expression indicates the betrayal of a secret.

Tongan legend ascribes the origin of this phrase to Tonga-fuji-fonua, Tonga the Land-Fisher, from whom the Maui procured the hook with which were hauled up from the depths of the sea many of the Tongan and other islands. Tonga-fuji-fonua lived in Manuka (Manu'a) in Samoa, and when the Maui's boat touched there the youngest Maui, Kijikiji, jumped ashore and met Tonga's wife, of whose person and heart he quickly made himself master. Tonga himself was away fishing at the time, and the woman confided to Kijikiji the secret of the right hook to select when they should make their request to him on his return. This hook was a rusty, unattractive object, and Tonga exclaimed when the Maui chose it, "Who has *tavatava i Manuka* for you?" An informant told Mr. Gifford that Tavatava was the name of the woman who betrayed the secret of the hooks to Kijikiji, but this appears a very doubtful derivation. We do not know the word in Tongan, though there are words which may contain the same root. Krämer states (Die Samoa-Inseln, II. Band, p. 423) that Tavatava is the name of a fish in Samoa, and quotes a song connected with the Tui Manu'a, in which this fish is mentioned (op. cit., I. Band, p. 422). Edward Tregear (Mangareva Dictionary) gives a word *tavatava* in Mangarevan meaning "clamorous and noisy in speaking; to speak shrilly or in a loud voice."

There is probably, however, some story or traditionary explanation connected with the phrase. In our ignorance of it mere guesses are futile.

368. **Kuo hange kuo emo e Faifaimalie:** It is as though Faifaimalie had licked it up.

Faifaimalie (Do gently, go slowly) was a goddess famous for her appetite. She especially distinguished herself during a visit to Pulotu. Not stopping at the food provided by her divine entertainers, she made a clean sweep of the baskets and other containers in which it was brought. Faifaimalie's lick, therefore, indicates a complete clearance.

369. **Tala pouli a puko:** The *puko* telling in the dark.

Baker renders this expression: "To backbite and be overheard by the party." Among the present-day Tongans this phrase seems to be lost, at all events with the meaning given by Baker. It has been also explained as meaning to disobey, to be told to do a thing and not to do it—an interpretation connected with the story of the speaking *puko* tree, which grew in Pulotu. The legendary traveller, Longopoa, who had made a journey to Pulotu, encountered this wonderful tree, which not only spoke but which was able to supply food, drink, shelter and other mortal wants. When leaving, Longopoa took a branch of this tree, which the tree itself told him to plant on his return to Tonga before he greeted his friends. Had Longopoa done as he was told the *puko* trees in Tonga, all of which sprang from this branch, would have been speaking trees like their progenitor. But the traveller neglected the warning and went to see his friends before he planted the tree. The *puko* tree in Tonga, therefore, does not possess the power of speech. In this account of the meaning of the proverb the significance of the words "in the dark" is said to be that the *puko* in Pulotu was accosted by Longopoa, supplied his wants and gave him his instructions during the night.

This tree in Pulotu is called by the Tongans the *puko lea*, speaking *puko*, and it is curious that a tree in Samoa which has an equivalent name (*pu'ao* and which is apparently the same tree, is called *pu'angangana*, speaking *pu'a*. (Krämer, Samoa-Inseln, II Band, p. 381.)

RELIGION

370. E unua e tevolo: The devil will be shifted.

Applied to one who is very hard to move. The idea is that it would be easier to shift a devil than such a one, hard as devils are to move. (Compare Nos. 358, 340 and 133.)

371. Fahu ae tapu: The prohibition is removed.

The word *fahu*, which is of great importance in the understanding of the social organization, indicates broadly rights enjoyed by reason of superior family rank. A tabu can be removed by one who has this superiority to the one who imposed it, and *fahu* thus comes to be a technical word for the removal of tabu. As a question this phrase is used to rebuke one who has presumed to do that which he should not.

372. Faka-momoa-tea: White fowl fashion.

This seems to be the literal translation, taking *momoa* as the reduplicated form of *moa*, fowl. The white fowl is said to be an omen bird. There are two principal senses in which the word is used; first, ominous, presaging evil; second, to weep for the living as though they were dead.

373. Hange ko Hina: Like Hina.

Hina was one of the most talked of goddesses, as Jinilau was one of the most talked of gods. Both are represented as very beautiful. Should a discussion arise as to the identity of a goddess in a tale the story was likely to be finally credited to Hina. Similarly Jinilau would probably be hit on if the name of a male diety were in question. So to say that anyone is like Hina means that he is much talked of, or much abused.

374. Hia i Fanakava: Criminal in Fanakava.

Fanakava was the name of a very famous sanctuary in Mua, the chief district of Tongatabu, and the home of the Tui Tonga and of other great lords. Up to the introduction of Christianity Fanakava afforded an inviolable sanctuary to all who gained it. The expression indicates a person guilty of some offense but secure from punishment.

375. Ji e he tevolo: The devil pushing.

Used sarcastically to one who is making a poor apology for his bad conduct, "H'm, the devil shoved you into it." This phrase, which is recent, is said to have originated with a man who went visiting a lady he should not have visited, and who, when put on trial for his conduct, defended himself by saying that he went to the woman without knowing what he was doing and that he supposed the devil must have thrust him into the house.

376. **Jio pe ka kuo i A'a:** Seeing but in A'a; equivalent to day-dreaming, absent-minded.

A'a is an island in Vavau where resided the two female deities Jiji and Faingaa, who used to appear in the form of the dark and light-colored heron respectively and to take the spirits of handsome men to their island. The bodies of the beaux thus deprived of their spirits would see and hear and to all appearance be carrying out their normal functions, but their souls were really far away.

377. **Mamahii tapu ka kuo ilo:** Solicitous for the tabu, but knowing.

This indicates one who is genuinely desirous of observing a tabu, but who knowing the value or charm of the thing prohibited is irresistibly attracted by it and may in the end even break the tabu. The story of Eve and the fruit has been quoted in illustration of this.

378. **Mana hoo tevolo:** May your devil have power (*mana*).

A threat of an angry man to another. Your god will need plenty of power to protect you from what I am going to do to you. In its present form it is modern, but with the substitution of some oher word for *tevolo* (devil) may well be ancient. Another form of the same phrase is *Manamana hoo tevolo ke ta fai,* May your devil have power for us to do (strive together). The meaning of the two phrases is the same. Either expression may be preceded by *Ofa ke,* I hope that.

379. **Ngali pe tevolo moe pouli:** Devil just befitting the darkness.

Sprites and ghosts and supernatural appearances usually show up at night. Applied to a person with a bad reputation to whom all sorts of bad actions are likely to be imputed. Having once got the reputation of a devil he is liable to be made to carry the blame for any fresh deed of darkness.

380. **Pekepeka-tama.**

This indicates the white flying-fox said to be an omen of disaster to the house of Ata the chief of Kolovai in the west of Tongatabu, and thence used generally of an omen, portent. The words seem literally to mean, Flying-fox lad, as though one were addressing the observation to another. *Tama,* lad, is frequently applied to chiefs irrespective of age, as *taahine,* girl, is used of chiefly woman. *Pekepeka* is the usual name for the swift (*Collocallia spodiopyga*), but in this instance seems to be a reduplicated form of *peka,* the flying fox.

381. **Tevolo hala he jikota:** A devil making a road of a kingfisher, that is, manifesting himself through the kingfisher (*Halcyon sacra*).

The habit of calling the old gods "devils" dates only from the introduction of Christianity. As this expression implies the kingfisher was one of the creatures of which the gods "made boats," as Tongan idiom has it, that is, in which they appeared. The proverb is applied to one who makes use of some other person or thing in order to effect his purpose.

382. To fuji aki vahaa ufi:

Baker renders this phrase, "A part of the heathen ceremony at the *Inaji*" (An English and Tongan and Tongan and English Vocabulary, p. 209). We have been able to find out nothing about this. Written as above it seems to have the perfectly simple sense of planting plantains between yams. It has been suggested that the correct meaning may be: to use the space between the yams as a measure to calculate the distance apart to plant the plantains. This also is quite in accordance with the literal meaning of the words. We may divide differently, and write, *Tofuji aki vahaa ufi,* which would seem to mean, "running in between yams." We have not discovered either what part of the *Inaji* was so named, nor what proverbial application the phrase had.

THE PERSON

CLOTHING AND ADORNMENT

383. Fie namu pako: Wishing to smell of *pako*.

The *pako* is a sweet smelling plant used for scenting oil, especially the oil of chiefs. The expression is capable of two kinds of application: desiring to do well that one's life and actions may have a fragrant odor, and the less generous meaning of conceit, trying to be like the chiefs.

384. Fuji mo omo: Pulling and slipping.

Used as noun or adjective equivalent to poverty, poor. Said to indicate literally one who is so poor that he cannot afford enough cloth for a proper sized *vala* (kilt), but has to put up with something so small that when he pulls it one way to cover a part of his body another part is left bare. Whether this be so or not it has come to mean those who have difficulty in "making ends meet."

385. Laukau falelava: Finery of various sorts.

Laukau, personal adornment, is used with the rather depreciatory nuance with which in English we speak of overdone, or over-vivid finery. *Laukau falelava* is not unlike such a colloquialism as, "Having 'em all on."

386. Mafana a penu kehe: Warmth of another's bed-clothes.

One man may have made himself very snug in another's covering, but can have no real ground of complaint when the rightful owner comes along and takes what belongs to him, leaving the snug man cold. So generally one may enjoy the advantage of using another man's property but he has no kick coming when the owner takes it to use for himself.

387. Maomao ki taovala: Ready, prepared with *taovala*.

The *taovala* is the girdle, usually a piece of mat, put round the waist before going into the presence of a chief. The phrase means to have the *taovala* always handy to be used whenever needed; hence to be prepared for any emergency that may arise.

388. Pule Taoa: Taoa finery.

Pule is literally "spotted," "variegated," as the design in some cloths, or the markings of a cowry shell. This expression is modern and is applied to an European print with a big, gaudy pattern. It is said that one day several women from Taoa, a village in Vavau, went into a store in Neiafu and bought some prints, apparently of rather striking designs. While they were still in the store a man came in and, seeing their purchases, remarked in the words of this expression "Taoa is going in for spots," and the phrase has stuck.

389. Tui momoa: Dry knee, that is, a knee that is hard and dry through exposure to the weather.

A woman's ordinary dress should descend below the knee; an exception is made of the festive dresses worn in dances and sometimes on other ceremonious occasions. This expression indicates primarily a woman so poor that she cannot afford a sufficiently broad piece of cloth for her waistcloth, and so has her knees exposed to the sun and rain and wind. It is used derisively of a poor person.

390. Vala kovi fie kofu silika: Bad loin-cloth wanting to be silk dress.

Evidently modern. The point is rendered plainer if the statement is correct that in the early days silk cost as much as £5 a yard. Used of a commoner who wants to act the chief.

FACIAL EXPRESSION AND GESTURES

391. Faka-alinga lelei: Making a fair showing.

This expression carries the implication that there are faults behind the pleasant exterior or that an amiable face may be the mask assumed by very unfriendly feelings.

392. Faka-pula-matai: Making eye swell.

Used of a very angry man, whose eyes protrude in his rage. May be used also of the victim of this rage, whose eyes may swell with vexation and grief, or who may even get a swollen eye through the physical application of the other man's anger; in this sense not unlike the English vulgarism of giving anyone a thick ear.

393. Hange ha matai fana hala: Like the face of a man who has missed his aim.

Such a man will be ashamed of his poor shot (with gun or bow and arrows), and may attempt to hide his confusion with inconsequent talk. Used of someone who has done what he is ashamed of, and whose shame is betrayed in his face and talk.

394. Hange ha tangitofuhia: Like a bewildered diver.

Tangitofuhia is used of the bleeding from nose and ears caused by staying a long time under water. In this place it seems rather to refer to a partial loss of consciousness resulting perhaps from striking the head or of staying under water too long, which renders the diver unable to find his way again to the surface. The unfortunate diver will swim about at random in his vain efforts to come up. Applied to one who wanders aimlessly about, or whose thoughs are erratic and disjointed.

395. Hange kuo takai kapa hono lae: As though his forehead were sheathed in metal.

Kapa is the local variation of copper, and is used for metal generally. This would seem to be altogether modern, probably suggested by Biblical language, though the same idea of hardy shamelessness is expressed in the Tongan phrase "Veiled with clam-shell." (See No. 241.)

396. Kamo lalo: Making secret signs.

Not strictly a proverb; it means that a number of people sitting together one is ironically complimenting another, or in some other way fooling him, at the same time making signs to the rest of the company and thus admitting them into the joke. It is used very much like the Australianism "pulling his leg."

397. Katakata a nifo tea: Smiling white teeth.

This is what Uncle Remus calls "a fit of the dry grins." A man may try to cover his shame or confusion with a smile; his teeth will be showing white as though he were smiling but the real feeling of his heart is far from laughter.

398. Lau lau louhulu: Fingering, fingering dried leaves.

A man who is ashamed or embarrassed is likely to break off a piece of the dried leaves with which the houses are floored and keep twisting it about in his hands as he talks; if outside of the house he will pick up any stick or other such thing that happens to be at hand.

So used generally of doing some more or less irrelevant thing to cover up deficiencies, or to hide one's shame and embarrassment, just as a man who is behind with his work may start hustling round to give the impression that he has been hard at it for hours.

399. **Malimali loto:** Smiling (in the) heart.

Satisfaction with what is one's own; self-satisfaction. The expression is said to have originated with the handsome man *(manaia)* Vainuku who lived in Eua where he had a little pool of water which he used as a mirror. When he saw the reflection of his handsome face the sight filled him with pleasure, made his heart smile. The pool itself was named *Malimali loto.*

400. **Mata mea fooua:** Seeing a new thing.

Indicative of the surprise and gratification experienced at beholding an unaccustomed sight. (See No. 267.)

401. **Pauu afi mata:** Mischievousness pulling down lower lid of the eye.

To pull down the lower lid of one's eye at a person is an insulting gesture; but this phrase refers apparently to one who should be so impudent as to do it to the eye of another, as for example a pert child treating thus his mother's eye. The expression means excessively impudent or mischievous.

402. **Tuai e kemo:** The wink (is) slow.

Instantaneous, very quick, literally much quicker than a wink of the eyes.

PERSONAL APPEARANCE

403. **Finemotua fie finemui:** Old woman wanting to be young woman.

A rebuke to the lady who refuses to grow old gracefully; but strives to cheat the advancing years with the adornments and manners that befit the young and fair.

404. **Mata kovi ka nae fili ekita:** Ugly but I chose myself.

The most direct application of this is to a man who has taken to wife a lady not specially dowered with beauty. She is not handsome, but she is the choice of her husband.

405. **Uliuli a fine Eua:** The dark complexion of a Eua woman.

The women of Eua were not reckoned beauties, but were well looked after and hard to come at. If a boat called at Eua the women would freely move about and perform the tasks incidental to the entertainment of the visitors, but at night were shut up and carefully guarded. The expression refers slightingly to these ladies, who, in spite of their lack of charm, were jealously watched.

406. **Jiijii a pakiji:** The wiry man is lean.

The word *pakiji* means lean but strong. There is a certain redundancy in saying that such a strong wiry man is thin.

407. Lahilahi a ngavaivai: A weak man is big, or the bigness of a weak man.

Big fleshy people have not the strength and endurance of those of lean wiry build. The companion phrase is *"Jiijii a pakiji,"* which indicates the tough endurance of the lean wiry man. (See No. 406.)

PHYSICAL DEFECTS

408. Fafa he ho nima ku: Stroke that with your stumpy hand.

Nima ku, that is a hand of which a finger has been mutilated by the amputation of a joint, is used familiarly for *nima,* hand. Before the introduction of Christianity such mutilation was extremely frequent, as finger joints were commonly sacrificed to the various gods. The expression is used by one who has done something that should prove gratifying to another; much as English speaking people say, "Well, what do you think of that?" The literal idea is that of fondling, caressing, with the hand, as though one should say "There's a deed, or a thing, of which you might well be fond."

409. Tonu a ulu-ku: Correctness of mutilated.

Refers directly to the customary mutilation of the hand by cutting off the top of the finger in sacrifice. A person with a hand thus disfigured might be very skillful in dances, many of which consist largely of motions of the hands, but the mutilation would to some extent mar the charm. So generally of that which is done all right, but is spoiled by some defect.

410. Kui lohiaki a: A shortsighted man pretending to have good sight.

The shortsighted man may try to conceal his defect by pretending to see things that he is unable to distinguish clearly.

411. Hange ha uku ha tula: Like a bald man washing his head.

A bald man needs but a very thin mixture of lime or clay and water to cleanse his scanty locks. So a weak, watery decoction of *koka* (coloring matter for the native cloth), or of some other mixture, is compared to the head wash of a bald man.

MISCELLANEOUS

412. Aofanga tuku: Head bound for hair burning.

The words used are chiefly. The place of a hair cut was taken in former times by a hair burn. In one method the lower part of the head was bound round with a green leaf of the *ii* (*Cordyline terminalis*) and then the hair singed off the top. This phrase means literally the leaf for the hair-burning, and is said to indicate that the leaf is ready adjusted for the process to begin. When the leaf is bound round there is no other preparation to make, everything is ready, and thence the expression has come to denote final, last.

413. **Faala fakatau ki he muiulu:** Looking (for lice) at the back of the head.

The back of the head is the favorite camping-ground of lice, and though the huntress may pick up a few strays in other localities it is at the back of the head that she is likely to make her largest bag. So used of looking for anything where it is most likely to be found.

414. **Tata a tua nima:** Nearness of back of the hand.

The back of the hand is very close to the palm, but when anything is grasped it is the palm only that touches it. Used of one who gets nothing when a close relative is distributing favors. In spite of his closeness he touches nothing.

415. **Teeki pea toki fakataane:** Break wind and then sit properly.

The uncouth first word is often exchanged for *angavale,* behave vulgarly. The phrase indicates one who squats down on his heels, or otherwise sits carelessly in company, and whose unguarded behavior is the cause of an embarrassing accident. Afterwards he sits as he should (*fakataane* is the sitting posture of the men) but then it is too late to repair the slip. Generally refers to one who after an accident takes the precautions that he should have taken before. Shutting the stable door after the horse has got out.

416. **Tufotufa ulu-nima:** Distributing (with) fingers.

Giving away grudgingly; not grasping heartily and offering with good will, but taking hesitatingly and unwillingly presenting something with the ends of the fingers. (Compare No. 111.)

HOME AND COMPOUND

417. **Ana jiko-makii:** Cave sullied with excrement.

Used of a place of human habitation or resort originally small and inconvenient and rendered still more so by the careless filthiness of those who use it. In connection with this it is asserted that caves were the earliest dwellings of the people. (See No. 425.)

418. **Hifo i toumua:** Going down to (one's own) frontage, that is, one leaving his house and going down to the road straight in front of his place.

The frontage is in line with his own property, and so the phrase comes to be used of one putting his hand to a task that is in line with his powers, undertaking that which he is well able to perform.

419. **Hikihiki kaua:** Shifting fence or boundary.

"Cursed be he that removeth his neighbour's land-mark." Boundaries are tabu and must not be tampered with. For the strong to shift the boundary of the weak would be a mark of tyrannous effrontery. The expression is a reproach to those who change what should be inviolably fixed.

420. Teketeke tuakoi: Pushing one, sitting with his back to mine.

This was sometimes done in sport, two people sitting back to back and pushing against each other. Frequently others would join in helping one or the other side. A proverbial use of this expression does not seem to be known today, but Baker gives: "To push away or remove the landmark of another to increase his own," which evidently pictures two contiguous compounds as sitting back to back.

421. Hiki moe faliki: Moving with the floor.

The floor of a Tongan house is formed of dry coconut leaves strewed on the ground and covered with mats. A man in shifting quarters will not usually takes these flooring leaves with him, but this expression indicates a migration so complete that it leaves the ground bare; house, floor, and everything being on the march.

422. Kama e mea ae api kehe: Attending to the thing in another's home.

This is much like No. 423, used of one who neglects his own business and attends to that of other people. (See No. 346.)

423. Kama noa he mea ae api kehe: To exert oneself for nought in the affairs of another compound.

To use one's energy in labors from which he will get no return; the fruit of his labors will go to those who own the compound.

424. Lepa tali ki langi: Cistern dependent on the sky; a cistern which is filled only by the rain.

The whole matter of water supply and conservation has been modified, of course, by the introduction of European roofing-iron and tanks. Of the cisterns dug formerly by the people some were filled by carrying water from springs; others were filled only by rain. As notable examples of rain-filled cisterns mention is made of natural holes in the rocks near the sea on the islands of Fotuhaa in Haapai, and Niua Foou. We cannot say whether any such expression as this was used in pre-Christian days to express the dependence of man on the gods, but it is used now of the reliance of man on heaven.

425. Takamilo jiko i tua peito: Going round defecating outside cook-house.

One should not bring any defilement near the place where his food is prepared, nor should he in any way dishonor his own home. The expression is much like the English proverb about a bird fouling its own nest. (See No. 417.)

426. Tu mo hokohoka: Lighting and dabbing, that is, lighting a fire and then dabbing the end of the lighted sticks on the ground to extinguish them; frequently lighting a fire and letting it go out.

Applied to frequently preparing food during the course of one day.

427. **Valoki e kulo ki he fakapaku:** The pot scolding the frying-pan.

An entirely modern adaptation of the English pot and kettle expression, and with the same meaning. (See No. 483.)

DOMESTIC RELATIONS

MOTHER AND CHILD

428. **Fakamui i mama:** At the end in chewing.

Mothers often feed young children by chewing up food in their own mouths and then transferring it to the mouths of the children. This expression indicates a mother who chews food for her child but deprives the youngster of his due by swallowing a portion of the food and giving the child the remainder. The literal meaning seems to be, "at the end of the chewing (she swallows)," or more probably, "(she gives the child) the end of the chew," that is, what is left after her own swallow.

429. **Kai tama:** Child eating.

Applied to parents who are unkind to their children, and also to those who are unkind to close relatives.

430. **Kuo ta ki hono uho:** It was struck to his naval-corn.

After the birth of a child the umbilical cord was cut by the father or male head of the household. The midwife placed the cord in a convenient position, and the father severed it with a hatchet uttering a wish for the future destiny of the child: that a girl would be beautiful; that a boy would become a great warrior or fisherman, and the like. So when anyone is peculiarly apt at some particular task or seems to have been born to meet some special circumstances that have arisen, it is not uncommon to say that his cord was cut for that, just as we say in English that he was destined for it.

431. **Lau tama fai ki he fatu:** Reckoning a child in the womb.

Wait till the child is safely born before you have anything to say about it, or any plans to make for it. It is just like our English expression, "Counting your chickens before they are hatched."

This recalls, though it has no very direct bearing on it, the story of a chiefly woman who died during pregnancy, and after the vault in which she was buried had been closed up those busy about the grave heard the cry of a child from below. The matter was reported to the King who ordered that the child should be named Finau Taeiloa, that is, Finau Unknown. This is said to be the origin of the name Finau Taeiloa.

432. **Ofa a fine paa:** Love of barren woman.

Great as the love of a childless woman may be yet it does not reach the intensity of the love of a mother.

433. Tama tongia: Child that can be substituted.

If a child dies the mother may get another child, and so be comforted for the loss of the other. This loss is not irretrievable, though grievous.

434. Tama tuu he fae: Child standing in the mother.

This is capable of varying application to the character and standing of the child conforming to those of the mother, but its primary reference would seem to be to the dependence of a child's rank on that of his mother. The child of a chiefly woman is chiefly, while the child of a chiefly man by a woman of inferior rank will take the status of the mother.

435. Vale ia tama: Foolish about a child.

The word *tama* is used of a mother's child. A different word is used when speaking of a child as the offspring of a father. This expression refers therefore only to the mother and recognizes the indulgence with which any extravagance should be regarded when it is the outcome of a mother's fondness for her child.

ADOPTION OF CHILDREN

[The adoption of children is an exceedingly common feature of Tongan social life.]

436. Ohiohi pea kovi: Adopted and bad.

This expression indicates that the affection of the adoptive parents has been lost, or tinctured with resentment, by some unworthy conduct of the child. The adoption has ended badly, or has come to a period where some at least of its friendliness has been replaced by less friendly feelings. This is similar to *Pelepele pea mele*, No. 439.

437. Tala kovi kae ohi: Speaking an ill thing but (then) adopting.

This is to refuse a request, perhaps with some anger, but afterwards to relent and grant what was asked. The idea seems to be that after the first churlishness one acts with as much kindness as though he were adopting into his own family the person to whom he had at first refused, but was now granting, the desired boon.

MISCELLANEOUS

438. Faka-pelea a vale: Making a pet of fool, with the obvious inference of the uselessness of such kindness.

439. Pelepele pea mele: Petted and coming to grief.

Should a favorite child, or any other who is petted, presume on the preference shown him and do wrong he will be punished. His petting will become a spoiling, not in the sense in which we use the word spoil, of a favorite; but the rank of favorite will be spoiled. It has a special reference also to wrong-doing by a chief's wife.

440. **Pele tonoi:** An adulterous favorite; one who returns the kindness of another by debauching his wife.

441. **He oku fola fala kae alea e kainga:** For the mats are spread and kin are talking.

The mats are the sleeping mats, and the picture is that of intimate domestic converse between those who may freely declare their minds without fearing the anger of their auditors, who, being their own kin, will stand even unfavorable criticism. Far different is this intercourse from the circumspection which must be observed in addressing the great of the land without the family circle.

442. **Talatala i fale:** Speaking in the house, that is, in the privacy of the home, and among close kin, as for example the admonition of a father to his son.

443. **Tala loto fale:** Telling inside house.

This saying does not seem to be known, at least not very generally known, nowadays. Baker renders it: "To speak evil; to speak, to incite to evil." Evidently the idea is of taking the opportunity of private intercourse to utter things which one would not like to say before many auditors.

444. **Apijia tae lava:** Ceremony that does not come off.

Applied, for example, to a man who writes to a girl, or otherwise tries to win her for his wife, but is unsuccessful in his suit. The word *apijia*, which is probably connected with *api*, home, indicates that which one does for himself, for his own home.

445. **Apitanga a lalahi:** Camp of grown up people.

Used of a place where grown people only are living together without any of the trouble and care incident to the presence of children. A boat's crew is sometimes thus spoken of.

446. **Fangu malingi i fale lahi:** Calabash poured out in big house.

The calabash is the receptacle in which the sweet scented oil for anointing the body was kept, and the name has come to be applied to the oil itself. Whether in this phrase we translate *fangu* by calabash or by oil the meaning is the same. The *fale lahi*, big house, is the house in which the young men used to live together. The phrase indicates the holding of something in common. If one man took out his bottle of oil to anoint himself another and then another might use it after him until perhaps the oil was finished. No offence, however, would be taken at this, as the owner would not assert his private rights against his fellow-lodgers in the big house.

447. **Kaumea kaumea faingamea:** Friends, friends quarreling.

The reduplication of the word *kaumea* (friends) indicates a long continued comradeship; but it is at last broken by strife.

448. Nonofo nonofo iloa ae tae oe nonofo: Living together, living together, the excrement of the living together (or of those living together) is discovered.

Baker renders it: "To live together for a length of time, and then find out the evil of so doing." This seems a very likely meaning, but the expression is also explained as equivalent to the English, "It's an ill bird that fouls its own nest."

449. Tangi ke vikia kae au ae kainga: Desiring to be praised but the relatives badly off.

This particularly indicates a chief who makes a liberal distribution of his food and other wealth, but overlooks the claims of his own immediate followers. He may earn the reputation of generosity from numerous people who have benefitted by his ostentatious gifts, but those whom every consideration of justice and gratitude should have recommended to his most kindly treatment are left to suffer want. Also written, *Holi ke vikia.*

450. Hala a jinifu: Wrong-doing of concubine.

Wrong-doing, punishment for which involves others besides the actual offender. If one of the wives of a chief proved false to her lord the whole harem shared her guilt and punishment.

451. Ofoofa a kui: Love of grandparent.

The love of grandparents is very sincere but their anger is to be dreaded, as in their wrath they may strike the offending grandchildren how and where they will. The love of one whose affection is undoubted, but whose position of authority is such that he may punish without let or hindrance.

COURTSHIP AND MARRIAGE

452. A maumau taimi: Awake, wasting time.

Applied, for instance, to the man who spends his evenings wooing a girl whom he has no chance of winning. Used also in derision by the warriors inside a fortress to the foe whom they see outside watching early and late for an opportunity to force an entrance.

In its present form with its employment of *taimi*, a corruption of the English time, this phrase is modern, but with the slight change to *A maumaunoa*, waking to no purpose, it may well be ancient.

453. Anefe ha taha a Majilamea: When was there anyone of Majilamea?

A beautiful chiefly girl of Vavau was courted by a chief of Majilame in Vavau. This gentleman was not a very glib speaker nor apparently wa he very lavish with his gifts to the lady. His courting was evidently rather dull infliction on the damsel. She was wooed and won by anoth man who was not a chief, but who had the art of pleasing speech and th further recommendation of being openhanded. The dour chief of Majilamea was rejected with the scornful inquiry as to when there was ever a man worth while from Majilamea.

Another rendering of this phrase, seemingly the more widely used, and probably the better, is *Kai pe tae a Majilamea* [Eat offal (excrement), Majilamea.] A delicate invitation of this sort is a common form of Tongan billingsgate. The expression has a wide application and may be compared in general with the Biblical question, "Can any good come out of Nazareth?"

454. **Fakakiki kae oho:** Trembling but making a rush.

This indicates the rushing of a man into the danger which he at first feared. An instance given of its application does not indicate very stern perils, being nothing more alarming than the fair charmer before whom a man finds himself embarrassed and fearful, but whom at last he wins for his own.

455. **Hoa a kehe:** Mating of different (sorts).

Those who are married, or in some other way united, but are not well matched.

456. **Manako Sea manako Sau:** Baker translates this phrase: "To be in love with two opposite parties or things."

This, or some kindred meaning, seems undoubtedly to express the sense of the phrase, but it is difficult to get today a reliable explanation of the literal meaning. *Sea* and *sau* are unknown as common nouns and if they are used as names their occurrence must be very infrequent. However, Dr. Krämer (Samoa-Inseln, I Band, pp. 121 ff. and 176) quotes both *Sea* (in composition) and *Sau* as Samoan names for women. The Tongan account of the proverb is that *Sea* and *Sau* were two beautiful women (probably Samoans), both beloved by a handsome man (Tuitonga in one account) who, being unable to make up his mind between their rival charms, in the end got neither. One story makes a happier ending by asserting that he got both.

457. **Mata lupe kehea:** Seeing other dove.

The word dove is used here of a sweetheart and seems to be a very old term of endearment applied by a man to his mistress. This phrase means a man who has become enamored of a new charmer and forgotten his old love.

458. **Poloji poloji pea koji kovi:** Long-haired, long-haired, and cut evilly.

The wearing of two long locks of hair at the back of a girl's head was a sign of virginity, these locks being cut at marriage. Virginity was highly prized in a bride and was marked by special features in the marriage ceremony. The expression indicates a girl who has lost the right to wear the maiden locks before being duly married.

Another explanation is that long locks were the sign of a betrothed maiden, and the expression means a maiden bethrothed by a chief who after all does not marry her. When finally she loses the virginal strands of hair it is not by being married to the chief she expected but by making a lowlier match. (See No. 459.)

459. Ikai ha lu loloi: Not a leaf cooked in oil.

Leaves of the taro and nowadays of the cabbage are frequently cooked with coconut and eaten. Used here as the symbol of the smallest and meanest kind of presentation of food. This phrase is not used alone, but as a completion of No. 458. The meaning is that the unfortunate girl has no sort of celebration; not even this trifling food gift falls to her share.

460. See so: Scaring off sweethearting.

Literally of a grave and reverend elder, or some such objectionable person, intruding on young men and maids. Thence of anyone "butting in" where he is not wanted.

461. Vale pe he valeanga: Foolish in the thing to be foolish about.

This refers to one who has been hard hit by the tender passion. A man madly in love may do many things that are not quite in accord with his customary well-balanced sanity, but what else is to be expected from a man in love? He is foolish, but under circumstances in which the whole world is apt to be a little less sane than usual.

462. Viku ae malo o Afitu mo Lakepa: The passion of Afitu and Lakepa is damped, or perhaps the praise of Afitu and Lakepa is damped, or perhaps the loin-cloth of Afitu and Lakepa is damped.

Whatever the literal translation the expression refers primarily to the disappointment suffered by the handsome *(manaia)* Lolo, son of the chief of Afitu, who had also some connection with Lakepa or its chiefly house. Lolo had been uniformly successful in love until one occasion when he was taking home in his boat a fair lady who preferred another gallant, named Lepuha of Leimatua in Vavau (Lolo also lived in Vavau it would seem), and who jumped overboard and swam ashore and joined her lover. Lolo's chagrin is expressed in this phrase.

Malo is a common word for praise, thanks, and possibly the expression means that the praise of Afitu and Lakepa has had a set-back.

Malo is also a small loincloth worn when one wants to be unencumbered with dress, as in fighting. The native cloth is spoiled by wetting, and so the expression may mean that the cloth is spoiled.

Another meaning of *malo* is the bloom of the breadfruit tree, and the explanation which involves this signification is perhaps on the whole the best. The bloom of thè breadfruit both from its shape and its function as a forerunner of fruit is likened to the membrum virile; and the expression is thus a very broad jest on the gallant's disappointment.

463. **Viku ae malo o Uiha:** The passion of Uiha is damped.

This is connected with two handsome gentlemen named Tatafu, one of whom lived in Uiha and the other in Haano, both in the Haapai group. Both went to Samoa to pay their court to a famous beauty. The Haano man was successful and the Uiha representative disappointed.

SPEECH, BOASTING, JESTING

464. **Fie matai:** Wanting to be craftsman.

Used in rebuke of one who "butts in" with his advice where it is not wanted; who tries to "boss the show." *Matai* is a Fijian word the Tongan equivalent of which is *tufunga,* craftsman.

465. **Tala a fine jii kae ikai mavivi:** A little woman saying but not able to do.

Bears its obvious interpretation of small people boasting of being able to do what is beyond their strength.

466. **Tala pea ngali:** Telling and befitting.

Used of one who says no more than he is able to do. His abilities befit his words.

467. **Vahe tala:** Dividing speech.

One who divides well, has excellent headings for his talk, but with very little doing to back up his talk.

Another term for what in Australia is called "skite."

468. **Hua fetaui:** Joking well contested.

Two who in the give and take of a battle of wit are well matched. So of those generally who are evenly mated. (See Nos. 469 and 597.)

469. **Hua feiloaki:** Joking of those accustomed to each other.

Like Nos. 468 and 597 indicates the contest of those who are evenly matched.

470. **Hange ha hua mo ha lautohi:** Like jesting with schoolchildren.

Wasting one's jests on those who cannot appreciate them, exercising one's wit on those who cannot be expected to be a match in the give and take of repartee. Generally of those who are not evenly matched. In its present form it is of course modern.

471. **Tuli pe hua ke malie:** A joke aims only at being pleasing.

There are those who in their jests give a certain amount of pain to others, but still we laugh for the object of the joke is not the pain that is given but the laugh. What is meant as jest should be taken in jest.

472. **Tupua tala kia tamaiki:** Riddle told to children.

Used of a secret that is not kept. If the answer to the riddle is told to children it will not be long before everybody else knows it too.

473. **Jio e mata kae hoka e tala:** The eye is seeing but the speech is wounding (stabbing).

Used of those who are speaking ill of another quite unconscious that the person defamed is looking on and listening to ill words spoken of himself. As an illustration the story of Muni is quoted. This legendary hero returning home at night is arrested at the door by hearing his foster-parents within discussing himself very much to his disadvantage.

474. **Longo moe loto.** Silent with the heart, or silent and the heart.

Used of one who is saying nothing but who has bad feeling in his heart.

475. **Tala i hanga mai:** Telling while looking at me.

Used of one who speaks fair and friendly words to another, but concealed in his heart are sentiments of a very different sort. A's real feelings towards B are very different from those expressed in his actual conversation with B.

476. **Aau e mala kehe kae tuku be hoto mala:** To explicate the misfortune of another but disregard my own misfortune.

Used of one who has much to say about the evils and misfortunes of other people, but who passes over his own in silence. *Mala*, translated as misfortune, has sometimes express reference to death.

477. **Fakahaohao mua:** Taking care, heading off, beforehand.

This is used of one who has a visitor whom he guesses has come to ask some favor which he is unwilling to grant. Before the conversation has got round to the point where the request will be advanced he talks in such a way as to make the petition difficult. For example, divining that his visitor has come to beg seed yams he forestalls him by remarking that he has had very bad luck with his yams this season, that they have all gone rotten, and that he does not know where to get seed to plant his garden. (See No. 478.)

478. **Lavelave mua:** Getting in ahead.

Like No. 477 refers to one who staves off a request which he does not wish to grant.

479. **Leveleva e malanga kae tau atu:** The speech is long but (may it) go home to you (my hearers).

This used to be a common termination of the speeches made by the *matapules* in the presence of great chiefs. Used generally it has its obvious meaning of a hope that what has been urged or asked for by the speaker will be done or granted.

480. Tala tae fai tuunga: Talk without making standing place, that is, to report something without adducing grounds of belief.

481. Tala tae fakaejia: Talk without putting a handle to it, that is, to tell something without adducing any proof or grounds of belief.

Baker understands the "handle" to one's talk to refer to appropriate action following on words, and translates the phrase, "To say and do not; to say one thing but do the contrary." The expression probably lent itself to both uses.

482. Tauange mo koe: I sincerely desire of you.

This is hardly a proverbial expression but is freely used in earnest entreaty.

483. Vale tala vale: Fool telling fool; one fool upbraiding another for his folly.

Used like similar expressions in English. (See No. 427.)

483a. Oku longo a Tonga: Tonga is silent.

Tongans are not in the habit of talking while eating and so this phrase is applied jocularly to a party of Tongans sitting silent at a meal. It is said to have been first applied by Fijians.

DISEASE AND MEDICINE

484. Avanga kai ate: Possession (by a spirit) consuming liver.

The liver is reckoned the seat of life and of at least some of the passions. The term *avanga* is applied to those illnesses which are caused by demonic possessions. Proverbially this phrase is applied to the yearning and distress of intense love.

It is worthy of note that in ceremonies the liver of a slaughtered pig is taken and presented to the chief. This is stated to be a presentation to the chief of the whole of the pig's life. (See also No. 485.)

485. Kuo toona hoku ate: My liver is baked.

This indicates distress. My life is consumed, wasted away.

486. Foki mei he uhi: Returning from the *uhi.*

Restoration to health from an apparently hopeless sickness. The *uhi* (*Evodia hortensis*) is largely used in native medicine, so largely that it perhaps stands here as the type of a drug which will be tried without much expectation of its proving efficacious when the practitioners are at their wits' end.

487. Hange ha inu vai tulotula: Like drinking *tulotula* medicine.

This particular member of the Tongan pharmacopoeia has no pronounced or unpleasant taste and one may drink it like water. Probably the drugs that enter into its composition are not very strong and they do not produce very marked effects. Used of one who drinks large quantities of liquids like kava or spirits without showing any effects.

488. Hange ha kainiloto: Like a *kainiloto.*

Kainiloto is an ulcerous or cancerous affection of the throat and nose whose nature is indicated by its name, which means eating inside. The disease has already committed serious ravages in the interior of the body before it becomes apparent on the surface. The phrase is applied to an evil which is hidden at first and only shows up when it has reached a very serious stage and is extremely difficult to cope with.

489. He oku ai ha hui kape loto: For is there a bone (needle) to pick out (what is in the) heart?

If one gets a splinter, for instance, in any external part of the body he can easily pick it out with a needle; but there is no needle that can pick out the secrets in the heart.

490. Kovi jiko ngaoi: To evacuate the bowels moving about is bad.

This is applied to a sick man, who, instead of lying down patiently and taking the care that his ill health demands, wants to be up and at work. His unwisdom is parallel to that of the man who should try to walk about while performing a function that is obviously inconsistent with walking exercise.

491. Mahaki fakapopo fala: Sickness rotting mat.

Refers to very protracted illness in which the patient is lying down so long that it might be said that his bed mats are rotting under him.

492. Malumalu talavai: Shady (for) getting medicine.

Probably a late phrase, dating from the establishment of the mission stations and of Government hospitals with their dispensaries. Such dispensaries are naturally in the larger villages and people often travel a considerable distance to reach them. The phrase indicates the cool of the late afternoon suitable for the journey to a village where a dispensary stands.

493. Mangu bea lau: Scab and touching with the fingers, that is, picking the scab from a sore.

Making a bad thing worse by meddling.

494. Papanga eiki: Level chiefs.

Papanga means to be disfigured by having the nose eaten away by a kind of ulceration not very uncommon in these islands. If the nose is gone the face is level, there is no boldly jutting out feature left. So of a gathering where there are a number of big chiefs none of whom has any marked superiority of rank over the others. In such circumstances the work of distribution of kava, food, and other materials, becomes difficult, as questions of precedence are then delicate.

495. **Hange ha fononga Makave:** Like people from Makave.

Makave in Vavau is reputed to have had an unusually large proportion of unfortunates disfigured by the ulceration, which destroys the nose. The expression is used of very well cooked food which is compared to the appearance of the victims of this disease.

496. **Tahataha e tama pea papala:** Only one child and afflicted with sores.

The original reference is to parents who have only one child, and that one covered with sores. The expression is applied to those who have only one of a thing, and that one is bad.

DEATH AND BURIAL

497. **Afia e mala kehe:** Keeping vigil in other people's misfortune.

The misfortune referred to is death. It is proper for the relatives of the dead to keep watch round the body. This expression indicates one who joins the watchers round the body of a dead person with whom he has no family connection. Among its applications is one to a man who pays unsuccessful court to a girl. He spends his nights and loses his sleep in visits to the young lady who in the end falls to the lot of some other wooer. As we might say in slang that is very near to the Tongan expression, "it has been somebody's else 'funeral.'"

498. **Lau hono fala:** His mat is reckoned, or his sand is reckoned.

When one is about to die people are sent to commence arrangements for interment by getting the sand up from the seashore to fill in the grave and build up the mound over it. At the present time this sand is carried in ordinary rough baskets of coconut leaf but previously it used to be brought in mats wound round the waist and having a large fold in the front into which the sand was put. The phrase means that death is certain. One frequently hears it, for instance, in games, said of a side whose defeat appears to be inevitable and imminent. (See No. 505.)

499. **Lelei ae ofa ki afitoka:** Kindness to the cemetery is good.

I feel kindly disposed to this person, but it is best that he be laid to rest in the burying-ground and that my love should go out to him there. Used, for example, of one who for a long time has been very sick, so that his friends despair of his recovery and are tired of looking after him.

500. **Hange ha mata tae pokia:** Like an eye not shut.

This refers to the closing of the eye of the dead. The expression is used of one who sleeps with his eyes open, also of a person with a frank open countenance, and of sun, moon, or stars when they appear clear and unclouded.

501. Hange ha mate mutukia: Like a cut off death.

Mutukia means trimmed, as for example the edges of the native cloth which are trimmed during manufacture. Thence *mate mutukia* means sudden, unexpected, death. The expression is used of the unexpected occurrence of a painful or disastrous event.

502. Matamatalelei fakafaitoka: Beautiful like a cemetery.

People may adorn and care for a cemetery but however well it looks it is still not a place that one feels much at home in. So used of that which is beautiful but fails to evoke the feeling of appreciative comfort that makes one desire to linger in its vicinity.

503. Noo ua poaki: Begging off being strangled.

Refers to the strangling of victims on the death of a chief or other circumstances of a like nature where a human victim was called for. This taking of life seemed a quite proper thing and ordinarilly evoked no popular dissent. This expression signifies literally that the individual to whom was assigned the leading part in the tragedy sought to evade his duty by an appeal to the people. So the phrase comes to mean attempting to beg off a duty which should be carried out.

504. Tala fai ki tano: Speech made to burying-ground.

Exhortation, commands, or other expressions directed towards the cemetery where there is none able to take heed and profit by what is said. So of totally unprofitable discourse.

505. To hono aveave: Plant his *aveave*.

A branch of the *aveave* (*Codiaeum variegatum* Pratt), was stuck into the ground in a cemetery to mark the spot where a grave was to be dug. When it was clear that a sick person was about to die a man was told to put in the *aveave*, which he did as a mark to direct those whose business it was to see to the digging of the grave and carrying out of the burial. The *aveave* was left at the grave to grow. The expression, therefore, is equivalent to saying that so-and-so is nearing his end, that it is all up with him.

It is interesting to note that a grave was not left open. The digging of the grave was one of the last pieces of work done in preparation for the interment and never done before the sick person was actually dead, though the *aveave* might be planted while the patient was still alive. In recent years we have seen a coffin made for an old lady, who though frail had vitality sufficient to do a little work even outside the house, and who survived by many months the completion of her coffin, which stood meanwhile on the side verandah of her house. Should an interment be postponed till the day after the grave had been dug, the hole will be filled in and dug out again on the next day. (See No. 498.)

506. Tuui tae fakakava: Visiting mourners without kava.

In visits to the friends and relatives of a person recently deceased it is customary to take gifts to the mourners, particularly to present them with kava. A visit without kava would lack the most important article which the comforters should take. This phrase indicates a visit unaccompanied by the "real thing," that which is the real substance of the ceremony. Generally used of that which appears all right but is more or less of a hollow pretence.

507. Vai kauaki: Water (for) dying man.

Used of that which is given to a dying man to satisfy any longing he may have. If he wants a drink of water give it to him. Literally it refers to giving the dying whatever they may want when it is obvious that nothing can do any good or any harm and that by satisfying any desire expressed at such a time the last moments may be made happier. We have also seen the phrase in a context that seemed to imply that the draught of water was life-giving; but probably the idea is that it restored the spirits of the dying man without giving him any real chance of life. Comforting, soothing.

WRONG-DOING; RETRIBUTION

508. E lavea ae taka nofo i he ngaue ae taka tuu: The good will be wounded by the conduct of the bad; wrong-doing which involves the innocent as well as the guilty in punishment.

Taka nofo and *taka tuu*, which mean literally, "he who sits" and "he who stands," perhaps get their meanings of good and bad, as applied to conduct, from the idea of one who sits quietly attending to his own business, and of one who must always be up and gadding round into mischief. Perhaps they refer primarily to the behavior proper to the kava ring where all should sit except when it is necessary to get up to perform some office connected with the ceremony.

509. Faifaimalie a nunua: Retribution coming on slowly.

Although the retribution of evil deeds seems to tarry, yet come it will.

510. Jii pe lele ae kaihaa kae fai: The thief's run is but short, but it is done.

If a thief is discovered he must make a bolt. Even if he is unable to run far and is soon caught he may as well make a dash for it and try to get away. Not a very successful attempt, but still a try.

511. Kaihaa tangi tauloto: A thief who wants to *touloto*.

Tauloto is to carry two burdens or baskets slung on the ends of a stick over the shoulder. If a man desires to steal he will be well advised to limit his depredations to what can easily be comprised in a single bundle and carried without difficulty. If he takes so much that he has to make up two bundles and carry them at the ends of a stick his chances of evading discovery and capture are much lessened. Not only so, but if caught he is much more likely to be forgiven if he is getting off with a swag of moderate size. If you are out for theft there is no sense in over-doing it.

512. Mala fai e tangata: Curse that man makes.

A curse that does not come from the unseen powers but is the fault of man himself.

513. Muimui a nunua: Retribution following after.

This is the pessimistic statement that sorrow is following on the heels of men.

514. Toka moe kafa: Lying with cord, lying down bound.

One who is not lying down because he wants to but because he is a bound prisoner and can not do otherwise. It may be translated also, "Existing with cord, existing bound," but the idea is precisely the same of a prisoner in bonds. So generally of a person who must pursue a certain course of action, of things that must of necessity be done.

COMMON PEOPLE

515. Fai faka-fatongia: Doing compulsory task fashion.

The *fatongia* was the forced service exacted from the people by the chiefs. This indicates a job that one does not set about whole-heartedly because he wishes to do it; but one which he does unwillingly and only because he must. "Government stroke."

516. Fiemua e tua ki mua: The commoner trying to outwit (a) chief.

The chiefs were the repositories of wisdom and knowledge; the commoners lacked their intelligence and experience. Consequently for a commoner to attempt to get the better of a chief was a mark of foolish presumption. So used generally of a man trying to outwit one wiser than himself, of an inferior attempting to get the better of his superior.

517. Ha fie matai koia e tangenge: A would-be craftsman that (that is) large.

Used in rebuke for forwardness, presumption. The nuance of the Tongan phrase is not greatly different from some such English colloquialism as, "Well, that's a pretty tall order." "You certainly have got some hide."

518. Jii kae ha: Small but appearing.

Used of one who wishes to appear to the chiefs or people but has very little that he can take as a present. Notwithstanding the insignificance of his offering he takes and presents it and achieves the prominence that he desires.

519. Kai foto a tua: Commoner eating sting ray's tail, or as we should say in English, making cannon fodder of himself.

The tail of the sting ray was used to tip the spears, and the sense is that of the commoner braving all the dangers of war, with the furt undemocratic understanding that however brave he may show himself he is nevertheless but a commoner. There is a couplet which runs as follows:

Tangi a tua ke tau ke toa,
Kae toatoa toe tua pe.

Which, somewhat freely translated runs:

A commoner wanting to be a great warrior,
But with all his courage remaining but a commoner.

520. **Lolinga a motu:** Habit of islet.

The word *motu,* translated islet, refers to the smaller islands scattered about the Tongan group. Although the largest island is only about twenty-five miles long the word *motu* is not used of it nor in general of the other more important centers of population. Different sections of Tongan population do not show the variation in manner and outlook that separates extreme rusticity from extreme "towniness" in white men's countries, but the manner in which the out-of-the-way islander does things excites something of the same half-contemptuous tolerance in the man accustomed to places where the elite of Tongan society are centered, as the country man does in the city man. All such comparisons as these, however, are vastly in favor of the Tongan over the European. In all places courteous good-breeding is the rule, and the foreigner's ignorant blunders are passed over with bland indifference.

521. **Ngu a tua:** Muttering of commoner.

A commoner may be vexed at something and complain but his anger is little regarded because of his social inferiority and consequent powerlessness. Another possible rendering is, "power or might of a commoner," but the application would be much the same as above. (See No. 522.)

522. **Ngungulu a feiumu:** Grumbling of cook.

Very similar to No. 521. A no account man like a cook may do a lot of grumbling but all the same he has to do what he is told and get about his job whether he likes it or not.

523. **Ngutu tamulea:** Officious mouth.

Used of a commoner officiously expressing his opinion in the affairs of chiefs, or generally of one putting in his say where it is not wanted.

524. **Tala be i tua mamao:** Report far outside; that is, the reports and conjectures of those who are far from the center of things where only the truth is to be discovered.

The compounds of the chiefs were fenced and only the *matapules* and the chosen few could have access to the councils of the great lords, therefore the conjectures of the rank and file outside the fence were likely to be far from the truth. The word *tua,* translated above "outside" is also used of the common people and *"tua mamao"* may mean "common people far down the social scale" rather than "far outside." In either case the meaning is the same; the unreliable reports circulated in the conversation of those who have no means of knowing the truth.

525. Tonuhia ae faiekina: The innocence of the oppressed, or the oppressed is innocent.

This takes a very pessimistic view of the course that justice is apt to run when dealing with the poor and unfriended. The poor man is in the right, but what then? He has none to take his part.

526. Tua fehui ua: Commoner asking twice.

It is not good form for a commoner to question a chief about the subject of his conversation. Should a commoner question a chief and the latter take no notice of the inquiry the commoner would lay himself open to the rebuke of this phrase if he repeated his interrogation.

527. Tua tala matangi: Commoner telling wind.

Baker renders the phrase: "One forward with his opinion of the wind, though among sailors."

528. Tua tangata kae eiki fekau: The man a commoner but the bidding (of) a chief.

This means that one chief has sent a messenger to another chief bidding him do something. Although the herald is a man of no account yet chief number two has to take notice of his message because it comes from lord number one.

529. Tuki a tua: Striking of commoner.

This striking is not that done with the fist or a club. It is the impinging of speech on one's mental processes. The common people are not well informed or skilled in affairs, and the phrase indicates the confusing of counsel by the unwise suggestions and ill-founded speculations of the uninstructed multitude.

530. Vale ngau fau: Fool chewing hibiscus (*Hibiscus tiliaceus*); a fool who chews hibiscus.

Term of abuse, but it is not apparent why chewing the hibiscus should be chosen as a special mark of folly, except that the plant is useless as food. The bark of the hibiscus is frequently used as a lashing and is often torn from the branch with the teeth to be utilized in this way. It is possible that the expression may have arisen as a designation of those who had to perform menial tasks; but we have no information on this matter.

CHIEFS

531. Aoao ki majijiva: Useful to poor; according to Baker "kind, thoughtful to the poor."

The care of the chiefs and provision of clothing, bedding and food for them was a heavy tax on the people. This phrase signifies primarily a chief who was easy to get along with; who was satisfied with whatever was at hand.

532. Eiki pea oi: Chief and striving.

The expression refers to a chief who, although he is a chief and able to enjoy his rank in safety and affluence, is not satisfied and sets on foot schemes by which he hopes to gain more. The upshot of his endeavors is the loss of what he had. Generally of a man who is not contented with the prosperity he has, will not leave well alone, and who through his discontented strivings comes off worse than he was before.

533. Hau ki nima: Lord to (by) hand.

Refers primarily to those chiefs who enjoyed great prestige not by right of birth but by right of conquest. Used generally of those who acquire privilege or status by violence.

534. Hau pea kui: King and blind.

Used of one who is a king but is regardless of the interests of his people. Especially it is employed of one who before his elevation to such high rank manifested good qualities that marked him as one fit for rule, but on succeeding to kingship changed to harshness and incapacity to win his people's affections. Not unlike Tacitus' "Fully capable of rule if he had never ruled."

535. Hongea moe houeiki: Enduring famine with the chiefs.

The chiefs were the great reservoirs into which flowed the food and wealth of the country; it was indeed tabu to eat the more valued kinds of food without first presenting the chiefs with their proper share. In times of scarcity the rank and file came off very badly but those who had the good fortune to be closely associated with the great chiefs were in the way of getting a share of whatever sustenance the country afforded. (Compare No. 544.)

536. Koe lau ia he koe tala ki he tui: That's talk. What, is it telling the king?

Used derisively by one man to another who threatens to report his conduct to a third person. Much like, "Pooh, what do I care if you do tell so-and-so? Is he the king that I should mind him?" (See No. 569.)

537. Lea hange ha Pelehake: Speak like a Pelehake.

The Pelehake is one of the great chiefly houses of Eastern Tongatabu. We have not discovered whether the Pelehake had any special connection with ceremonial or other speech or whether this proverb refers to the fact that the chiefs generally were the great repositories of information about correct and graceful language and ceremony. The phrase means to speak well, with well-modulated resonant voice and forceful, graceful diction.

538. Oku hiki mai pe ho mua vala ka koe Haafeva pe koe: The front of your *vala* is lifted but you are only a Haafeva man.

This refers to the chiefly *vala* or dress, called *vakai,* which consists of a very large piece of native cloth wrapped in several thicknesses round the waist, and with the outside end rather high up on the left side of the front of the body. This whole dress covers the body much further up than does the ordinary *vala* or waist-cloth. It is said that a foreigner called Fauolo went to live in the island of Haafeva in Haapai and that his daughter bore a son to a chief belonging to the Tui Tonga's family. A child who is chiefly on one side only is said to be *ila, ila* to, or of, such a chief. Fauolo's grandson gave himself the airs of a great chief, and this phrase is the rebuke administered to him by chiefs whose birth was noble on both sides. The expression may be used generally as a rebuff to those who wish to pass themselves off as something greater than they really are but is especially the taunt of chiefs whose blood is chiefly on both the father's and the mother's side to chiefs whose birth is plebeian on one side.

539. Pule faaoa: Rule violently seized.

Scarcely perhaps to be classed strictly with proverbial expressions. It means authority which has been usurped, or grasped by the strong hand.

540. Talafono a Pakava: Instructions of Bakava.

Bakava was a Fijian chief who used to give instructions to his people that they must not eat the *tava* (*Pometia pinnata*), a pleasantly flavored edible fruit, while he held himself exempted from his own "tabu," and freely plucked and ate the forbidden fruit. This expression is applied to a chief who prohibits to his people a privilege which he himself enjoys.

THE TUI KANOKUPOLU

[The Tui Kanokupolu is a great chief of Western Tongatabu into whose hands regal power was more and more passing with the decline of the Tui Tonga. The birth of several notable warriors and statesmen into this family and the trend of events after the introduction of Christianity have resulted in placing the present constitutional monarchy of the whole Tongan group in the hands of this house. The title of the King or Queen of Tonga is now Tui Kanokupolu.]

541. Faka-Pangai: Pangai fashion.

Pangai is the name of the residence of the Tui Kanokupolu and there are a number of localities scattered through the group which bear this name on account of their association with the Tui Kanokupolu. When presenting food to the Tui Kanokupopolu the donors would desire to make their gifts seemly and consonant with the dignity of the great chief. Small gifts, therefore, would be wrapped up in large coverings and placed in capacious baskets. The expression, which is confined to gifts of food, is "applied to small quantities of food put into large baskets." (Baker.)

542. Koe moa kehe oku uua i Pangai: It's a different cock that is crowing in Pangai.

Pangai is the name of the place where the Tui Kanokupolu holds his court and has become the proper name of several localities in the Tongan group, certainly in many instances, and probably in all, through association with the Tui Kanokupolu. The expression indicates one who has no right to the privilege of speaking in the royal *malae,* or meeting ground. The expression is used, as would be a similar phrase in English, as a rebuke to one who speaks where it would be more seemly for him to keep silent.

543. **Laujii faka-Hihifo:** Narrow in the western way.

Hihifo, meaning literally the point where the sun sets, is the general name given to the western districts of the various islands. Here the district indicated is the western part of Tongatabu, which is narrow, and whose circumscribed area one might naturally expect to find reflected in a paucity of provisions. It is the seat of the great Tui Kanokupolu chieftainship, and its people by a wise use of their resources never fail to set forth a ceremony or banquet with true chiefly munificence. The phrase is used of those who by their prudence overcome the niggardliness of nature.

544. **Nonofo mo Tukuaho kae fie kai gako:** Living with Tukuaho yet in want of rich food (literally fat).

This is a very unlikely contingency, for Tukuaho, one of the Tui Kanokupolu who reigned at the close of the 18th century, was a great chief and those in close contact with him would be sure to be well supplied with the best food that the country could furnish. See No. 535 for a similar expression of the belief that the vicinity of the great chiefs was the place to find the best provisions that the country afforded.

545. **Oua e tangi ke tatau** Don't desire to be equal
Naa ita a Taufaahau: Lest Taufaahau be angry.

Evidently of recent origin, as the use of the name Taufaahau began with the famous George Tupou I, whose name it was. The sense is, smaller folk should not try to make themselves the equals of such a mighty chief.

THE TUI TONGA

[The Tui Tonga and his house were the pinnacles of Tongan nobility, claiming descent from the gods. The sister of the Tui Tonga was the Tui Tonga Fefine, Female Tui Tonga, and had rank superior even to the Tui Tonga himself. Since a Female Tui Tonga who was sister of the reigning Tui Tonga did not lose her rank if her brother pre-deceased her, but held it till her own death, the Female Tui Tonga was either aunt or sister to the contemporary Tui Tonga. The first child of the Female Tui Tonga by one of two special chiefs was the topmost pinnacle of Tongan nobility, particularly if a daughter. This first born child was called the Tamaha. Should a son be born to the Female Tui Tonga and afterwards a daughter it would seem that the daughter was the Tamaha. There appears however to be a little laxity in the use of this title. The actual power of the Tui Tonga has evidently been declining for centuries, and passing more and more into the hands of great lords, notably the Tui Kanokupolu of Western Tongatabu. The decline of prestige which inevitably follows sooner or later on that of real power was already apparent before the coming of the Europeans and Christianity hastened the political changes which have almost completed the process.]

546. Hala o Taanea: Way of Taanea.

This is an expression used by one in claiming for himself, not arrogantly but almost apologetically, a place or right from which he has been formerly debarred. Different tales are told of the origin of the phrase. One account says that there was a great warrior called Taanea who had no seat in the kava ring until at last he went to a kava ring and with the customary word of apology, much like the English "Excuse me," merely sat down in the circle. Another account refers the name Taanea not to a man but to the place Taanea in Vavau. According to this story a Tui Tonga who was living in Vavau was one day being borne along in his litter and came to a place where a man named Fukofuka was digging. Fukofuka left his work and took a place among the Tui Tonga's bearers and went right on without a change till the party reached the cemetery at Taanea. The Tui Tonga then thanked him for keeping so long at this task without a rest and told him to run, and that he could have as much land as he ran round without stopping. Fukofuka, notwithstanding his previous labors, completed the circuit of a large piece of land which the Tui Tonga duly gave him. This is said to be the reason that the chief Vahai holds Taanea, for Fukofuka belongs to a younger branch of the Vahai family. Fukofuka, apparently when he returned from his run, found the Tui Tonga drinking kava and was given by him a seat in the upper part of the circle (*alofi*). Fukofuka, with the appropriate word of apology, passed to his place. So anyone going to a place or claiming a privilege to which he is not strictly entitled may say "Way of Taanea," as a sort of apology.

547. Ka i Mua: Speaking in Mua.

Applied to one who is expert in the procedure of ceremonies, dances, and other functions. He is a man of sufficiently chiefly rank to be among the important people in the chiefly town of Mua, a name most often used for the important village in Eastern Tongatabu associated with the Tui Tonga, but which is also a name of the chief town in a country. Applied generally to one who is very skillful in anything; it is only to be expected that so-and-so should be proficient.

548. Nofo i he api Moli kae fu hala: Living in the compound called Moli yet clapping wrongly.

The compound called Moli was a residence of the Tui Tonga and was of course a center for the practising of dances and for all the ceremonial connected with the kava and such matters. In some dances time is kept by clapping the hands, and in kava drinking the person whose name is called to receive the cup that has just been filled claps his hands to indicate his position. Clapping, therefore, is used in this expression as a type of the general behavior and ceremonial connected with dances, kava, and other matters whose chief center and exposition is in the Tui Tonga's court. To live in the midst of opportunity and yet to obtain little advantage from it.

549. **Pulu e tuku:** Easy with the rope; let down gently.

The *tuku* is in this instance the rope with which the slab was lowered on to the top of a vault. It is said that the man whose duty it was to arrange the body of a Tui Tonga in the vault would often try to steal one of the fine mats wound round the dead chief's body. To be able the better to accomplish this purpose he would endeavor to get one of his friends on the end of the rope with which the stone cover was lowered over the grave, and would adjure him to let down slowly. If he were shut in the grave he would have to stay there and die, as the vault could not be opened to let him out without imperilling the life of the new Tui Tonga who had just succeeded.

We have heard this phrase repeated with the addition "that I may live"; "Let down gently that I may live," which looks as though at one period the man who descended into the vault ran some danger of being shut in even without wasting time down below trying to steal valuables from the body of the chief. One might hazard the conjecture that it marks a transition from a period when the man who went down into the grave with the Tui Tonga always stayed there and that the story of the mat stealing is an invention of later times. In front of a row of Langis, or Tui Tonga vaults in Mua, Tongatabu, is a row of smaller vaults which are said to be the escorts to the larger Tui Tonga graves to which they are contiguous. It is stated that these vaults contain the bodies of the *matapules* of the Tui Tonga, though there is no statement that the *matapules* were made eligible for the grave for the special purpose of occupying their proper official position in the entourage of their dead chiefs. Sometimes the expression is enlarged, *Pulu ho tuku tata ho vae,* Let go gently with your rope, dig in your feet.

Proverbially the expression means to go slowly and give one a chance of escape.

550. **Sani Tungua:** Tungua glory.

The island of Tungua, in the Haapai group, although it is tiny and out of the way, was yet the residence of the Tamaha, the child of the Female Tui Tonga the peak of Tongan nobility. The Female Tui Tonga also seems to have spent much time there. One of the two chiefs who were the usual mates for the Female Tui Tonga holds this island as part of his estates and the modern holders of the title have frequently resided there. All this chiefliness clinging about the islet of Tungua is the boast of its people but the expression *"Sani Tungua,"* rather strangely, is used ironically of one who boasts of what he will do for another and what he will give to him but who has not the material backing to make good his words. The idea evidently is that the resources of the little island are not commensurate with its chiefly pretensions.

551. Tutungia a hulu Tungua: Shrivelling of Tungua leaf.

A thing that is past its prime or damaged, but yet valued. Tungua was a residence of the great chief women, the Female Tui Tonga, and the Tamaha. The expression is said to have originated in the fact that there was once a Female Tui Tonga who suffered from some facial disfigurement. She apparently is the shrivelled Tungua leaf. Whatever misfortune might befall so great a personage she was still the Female Tui Tonga, and so to be regarded with reverence.

552. Tuanaki Auka: Depending on Auka.

Tradition says that Auka was one of the men in close attendance upon the Tui Tonga, Telea. On account of a wrong committed by Talafaiva, the wife of Telea, Auka was bidden by his royal master to take her and kill her. Auka performed the Tui Tonga's bidding to the letter, much to the chagrin of the latter, who loved Talafaiva dearly and who supposed that Auka knew his heart sufficiently well to understand that he did not really desire his harsh order to be carried out. Hence a vain confidence, to depend on one who does not come up to expectation.

553. Vete fakafutuna: Plunder like the Futunans, that is, to plunder completely, strip of everything.

The Tui Tonga, Kauulufonuafekai (16th century?) the great voyager and warrior, went in pursuit of the two men, Tamajia and Malofafa, who had murdered his father Takalaua, the previous Tui Tonga. Kauulufonuafekai and his brothers pursued the murderers from island to island, at length coming up with them in Futuna in the New Hebrides. A battle followed after which the Tongans withdrew to a small island called Alofa, but by a misadvertence Latu-toevave, the youngest brother of the Tui Tonga, was left behind on the island where the battle was fought. The Futunans did not kill him but by his advice did obeisance on the following day to the victorious Kauulufonuafekai. Peace was made between Futuna and the Tongans and the Tui Tonga, in recognition of the kindness of his late foes in sparing the life of his brother, ceded to them the right to take for their own any Tongan boat that might touch at their shores, and all that it contained, stipulating only that the people should in no way be molested. This right has been exercised by the people of Futuna and has apparently been carried out so thoroughly as to pass into a proverb.

(Compare the Samoan word *faatafuna,* to lay waste. Possibly *tafuna* became *fatuna* by metathesis and then through misunderstanding was altered to *futuna,* the name of the island.)

KAVA

[The dried root of the kava (*Piper methisticum*) is ground and well mixed with water. The dregs of solid root are strained out and the infusion drunk. It is the indispensable adjunct of ceremonies, and even a party of friends sitting together do not drink kava without a considerable amount of formality. Proper precedence in the kava circle is most carefully observed. A chief's rank is accurately indicated not only by his position in the ring but also by the order in which he is served.]

554. Fele a toua: *Toua* is widely scattered, that is, a multitude in the *toua.*

The *toua* (pronounced to-wa) are those who sit where the kava is prepared in a kava ceremony; they are, for the most part, people of no rank and do not drink the kava, that privilege being reserved for their superiors in the *alofi,* or chiefly circle. This expression then indicates a big crowd of people who do not count for much.

555. Fufu mo kokohu: Clapping (the hollowed hands) and dust rising.

When there is a shortage of kava the people are constrained to use the little rootlets projecting from the thick part of the main root which in times of plenty they would throw away. To cleanse these rootlets of adhering earth they are rubbed in the hands, then held in the hollow of one hand while the other hand is beaten down on top of them, thus causing dust to arise. This expression is used in a deprecating way by a man who has only a small piece of kava to offer to his friends, and indicates that with this small piece he is completely at the end of his resources.

556. Molumalu faka-fono: Good appearances, *fono* fashion.

The *fono* is the food served with the kava. The distribution of food with kava is frequently a mere formality to comply with ceremonial requirements, and the little food given out is seldom eaten. The phrase indicates therefore appearances that are only appearances without any solid backing of substance.

557. Nofo e fononga kae eke kava: The visitors having no share, but asking for kava; or perhaps more intelligibly, asking for kava, but the visitors having no share in it (literally, the visitors sitting, that is, just sitting quiet without part or lot in what is going on).

If guests arrive at one's house it is proper to prepare kava to greet them. This phrase indicates one who should ask for and obtain kava but then takes it off and uses it for some other purpose, neglecting the obvious duty of polite hospitality of preparing the beverage to greet his visitors.

WAR

558. Fakalali pakola: Like drum of prisoners of war, that is, the peculiar beating of the drum indicating that prisoners had been taken.

Cannibalism was only sporadic in Tonga, and never widespread. The word *pakola* is of Fijian introduction, and in Fiji indicated prisoners of war designed for the oven. Baker considers it an introduced word from Fiji, used in a low way for "Die, you wretches." In Fiji, therefore, the *pakola* drum would seem to indicate that the butcher was about to call, but such a meaning can never have been general in Tonga.

559. Fakatoa tele: Do-or-die courage, or rather, like a do-or-die hero.

Meaning and application follow closely the English.

559a. Fakate a Halia: Marshalling of Halia.

Used of a numerous crowd of people who, in spite of their numbers, are inefficient and unable to carry out the work for which they were assembled. It is said that the phrase originated with certain fighting at Halia, in the island of Foa, in Haapai. One of the armies engaged was large but was defeated by its less numerous antagonists.

560. Kuo totoa hono nima: His hand is bloody.

The warrior who has slain one man is thereby incited to further warlike deeds. Generally of the encouragement to further effort which is given by initial successes.

561. Longolongo ai valu: Omen of war.

Used with much the same meaning and range of application as the English "Calm before the storm." The last two words of this phrase are Fijian, and it is possible that the whole phrase may have been brought from Fiji, and the Fijian *rongorongo* modified in the usual way to *longolongo*. *Rongorongo* is the same word, however, as the Tongan *longolongo*.

562. Malanga fai i he ate: Speech made in the *ate*.
Malanga fai mei he ate: Speech made from the *ate*.

The *ate* is a shrub. The expression indicates being too late in speaking about a thing, or in preferring a request.

The story is that in the fighting of about a hundred years ago one of the regiments from the east of Tongatabu, the Pelehake regiment, dug a great trench in the western part of the island, with the object, it is said, of cutting off the western district from the remainder of Tongatabu. They worked hard and performed prodigies of labor during the night and at about daybreak bathed and rested. The great Vahai, the most formidable of their opponents, happened to sail along in his canoe near to the spot where they had bathed, and noticed the oily appearance of the water, due to the washing of the warriors' heads, and the marks where clay had been turned up (clay being the detergent used by the bathers). Vahai could see by these signs that a great number of people had bathed and guessed at once that so numerous a body of men could be nothing but an army. Landing with his own men to investigate the matter he found the Pelehake people all asleep and slew them. Among the doomed host was one warrior, evidently a fighter of renown, who was standing upright with his eyes open. Vahai thought him awake but in reality he was fast asleep. Vahai pierced him with his spear and the sleeper, suddenly awaked, jumped aside into the bushes *(ate)* and begged for his life, but in vain. He was slain with his companions. Hence this expression indicates an unavailing petition, a request that is made too late.

563. Mata ki vae: Face to foot, that is, one who is face from head to foot, whose whole body is skillful and alert.

Applied particularly to the warrior who is not only bold and able in the use of his weapons but is also fleet-footed and able to escape by flight when flight is necessary. Used generally of the man who is capable and active in every direction.

564. Ngungu tau: Sounding war.

Applied primarily to the beating of the native drum for war. There were different ways of beating for different occasions. The war beat evidently produced a very full clear note, and *ngungu tau* has come to mean the note of the drum when it is specially resonant. Such a sound is today regarded as an omen that somebody will die; possibly a reminiscence from the real war beat which was a call to death. Like No. 308 this is used proverbially of signs that something is going to happen.

565. Pona-tuu: The exact literal translation is uncertain. It is perhaps Standing death-blow.

The thing indicated is the last effort of a warrior who seeks to slay a foe in the instant of his own fall. A great champion (*toa*) was regularly accompanied by a companion (*hoa,* comrade, *hoa-tau,* comrade in war), who was himself a doughty warrior, the friend of the greater champion in peace and his close attendant in battle. In a struggle between two champions their respective companions assisted them by attacking their adversaries from behind, each champion thus having two enemies to attend to. Should it become manifest to one of the champions that he must be overcome he would strive with his last effort to strike backwards and kill his opponent's companion as he himself fell. This last backward stroke was the *pona-tuu.* Applied generally to the final, supreme effort.

566. Popoto faka-Tongatapu: Tongatabu reconciliation.

Tongatabu was a land of war, and it was difficult to know whether a reconciliation were genuine or deceptive.

567. Ta e ta kae tapa e tapa: The strikers strike and the reserves are in reserve.

It was the business of the reserves to shout and tell who were slain. The meaning of the phrase appears to be, everybody doing his own job, both those whose business is the actual fighting and those whose function it is to report the progress of the battle.

568. Ta e toa tuu e toa: A champion struck down, a champion standing.

This means that after one great warrior is slain another steps forth to oppose the foe. The word for warrior, *To'a,* differs from the word for the tree, *toa,* (*Casuarina equisetofolia*) only in having the glottal stop, and the phrase is sometimes given the meaning that after one casuarina tree is cut down another grows up. In either case the reference is to the same thing, the labors and struggles of one mighty man who has fallen are taken up by another. This proverb appears in a couplet, "*Ta e tea tuu e toa, Iloga he vale bea hola.*" "A champion has fallen, a champion stands, let him who is unskilled flee."

569. Tala pea taki mai ha tau: Tell and bring an army.

Like number 536 a derisive retort to one who threatens to report one's conduct. Tell and bring an army to back up your censure. What difference is it going to make if you do tell so-and-so? Is there going to be an army sent to punish me? The same idea is expressed also by *Tala pea e fai ha tau:* Tell, and is there going to be a war?

570. Tata langovaka: Striking compensation, that is, fighting again to compensate for a previous defeat.

One will use his utmost endeavors to make good the earlier defeat. Used generally of putting forth one's full effort so as to compensate for a previous failure.

571. Tau kovi pea kovi hono toi: Bad fighting and bad hiding.

A skillful leader may make good the deficiency in numbers of his troops by a wise use of cover. This indicates a state of things that was bad enough in the beginning and was not remedied by judicious management.

572. Tofi-kulu: Head splitting; a knock-out blow.

Used of a final, decisive stroke, an unanswerable argument. The word *kulu,* head, is interesting as showing the initial *k* which has been replaced in the ordinary form of the word by the glottal stop.

573. Tulituli ta: Chasing up (the) stroke.

An expression from warfare, indicating one who is pursuing a fleeing foe and is just about within striking distance. Applied to one who is putting forth all his effort to accomplish something which he is on the point of bringing off.

574. Vava faka-Vaipoa: Rejoicing Vaipoa-like.

Vaipoa is a village in Vavau. The phrase is applied to joyful expectations that are not realized. The expression is said to have originated with a great warrior named Mahina who lived in Vaipoa. It was customary to hold a kava ceremony on the eve of battle, and during the ceremony the braves would boast, or pledge themselves to valiant action. It was not unusual for a warrior to boast that he would kill the first foe that should be slain. This of course pledged him to rush foremost into the thick of the battle. Occasionally the chief of the army would give to the champion who pledged himself to such an undertaking the most important cup of kava, in this case the first, the chief's own. On one occasion Mahina with his fellows of Vaipoa was on a warlike expedition and at the kava preceding the battle Mahina pledged himself to slay the first of the enemy and was given the principal cup by the commander-in-chief. The army raised a shout of joy on hearing the pledge of Mahina, regarding the undertaking of so noted a warrior as a thing already as good as done, but when the battle was joined the honor of first blood fell to another. The chief on being told that Vaipoa had not succeeded in performing his vaunt, remarked in reference to the earlier confident applause of the hero's admirers, "That was Vaipoa rejoicing."

575. Ta ae uluafi: Slay the first foe; the head of battle.

Ulu-afi seems to mean literally the head of fire, and is a term regularly used of the first man killed in battle. To kill the first foe is used of overcoming initial difficulties, securing a first success, in much the same way as we speak of drawing first blood.

576. He oku puli ae kava i Atata? Is the kava in Atata lost to view, or forgotten?

Atata is a small island just off the coast of western Tongatabu.* Just before engaging in battle it was the practice to hold a kava ceremony at which the first cup was sometimes given to the warrior who pledged himself to be the first to slay one of the enemy. The first slain was called by a special name, *uluafi,* which apparently means literally "head of fire." On the occasion commemorated in this expression the kava before battle was drunk on the island of Atata, the first cup being duly claimed and drunk by a certain brave. When the battle was joined and the first of the enemy slain the commanding chief asked who had struck him down, when the warrior who had taken the pledge of the first cup answered, "Is the kava in Atata forgotten?" thus proudly asserting that he who had pledged himself in the kava was of course the one who had performed the feat.

SPORTS AND GAMES

LAFO

[*Lafo* is a game played by throwing large beans or disks of coconut-shell along a mat, the object being to make the disk stand as close as possible to the edge of the mat. The mat is bolstered up along the sides so as to present a concave surface. Usually it is played by teams of two, a pair of opponents sitting together at each end; but there was a form of the game in which the single men were replaced by groups of five, thus making teams of ten—two groups of five each at either end. In this form of the game the leaders of the fives sat at the ends of the mat two pairs facing each other, while the remaining parties of four sat round the corners, at the sides of the mat, and turned slightly aslant so as to face along the mat. There were five pieces to throw, and in the game where there were five men instead of one, each man had but one piece; in the form played by teams of two each man throws five pieces. Opponents throw alternately. The score is reckoned from six to ten, these five points constituting an *ulu,* game, and the winning side is that which scores the greater number out of five *ulus.* In the case of the sides being equal with two *ulus* each the fifth game is scored from one to ten, thus having ten points. *Lafo* is a fine game, but little played now.]

577. **Aufua a Tefuli:** Coming up the side of Tefuli.

This is an expression from the game of *lafo,* in which Tefuli was a past master. The expression indicates that which is excellent, manifests wonderful skill. Tefuli was a man of no particular rank who lived in Feletoa with the chief Ulukalala, probably the Ulukalala (Finau) who was Mariner's friend. Tefuli was extraordinarily skillful at *lafo* and could at will make the pieces go to the very edge of the mat and even project slightly over the edge without falling. It is related of him that on one occasion he visited Tongatabu and went to Mua, and played there at *lafo* with one of the Tui Tonga family as his partner. The match was very close, each side having scored two games, and in the fifth game, the final one, they were equal within one point of the game. In the final throw all of Tefuli's pieces went over the edge of the mat, while his opponent's stood in good scoring positions from which it was practically impossible to dislodge them, until Tefuli's last throw, when he made his piece slide along the edge of the mat, round his opponent's pieces, and balance itself delicately overhanging the edge, an almost impossible feat. Only after this exploit did it become known that the wonderful player was none other than Tefuli. For this exploit he received gifts and land. Before the final throw his partner had promised him that if he did not succeed with it he would put him to death. The phrase has accordingly a proverbial application in addition to the accomplishment of the seemingly impossible, namely that in which it is death to fail.

578. **Fua tuku ulu:** Measure concluding game (*ulu*).

An expression from *lafo.* In the event of a dispute arising as to which of two pieces is nearer to the mark it may be agreed that the distance be measured, and the game *(ulu)* decided straightway by that measure, quite irrespective of the points which each side had already scored. It may even happen that the game be won in this way although there are other pieces nearer to the edge of the mat than the two over which the discussion arose. Used of a decision or judgment which is to close dispute, is to be final.

579. **Kai pe ae toekai:** The *toekai* naturally scores.

In *lafo* the man who threw last was called *toekai* (this was also the name of one of the pieces), and the man who threw first was called *tukumua* (also the name of a piece). The *toekai,* having the last shot, had the best chance of scoring, and with players evenly matched almost invariably did score. In general the phrase indicates the success of one who is most advantageously placed; it goes without saying that such an one will be the successful party.

580. **Mata lafo lau kai:** Looking on at *lafo* counting score.

It is a piece of unforgiveable presumption for the onlookers to call out the score. *Lafo* was preeminently a chiefs' game and players would usually be of superior rank to the spectators. It is said that in earlier days a man might be struck down for venturing to utter the score aloud if he were not playing himself. Much like the English "Mind your own business."

581. **Nai huni:** Sparing oil-rag. A *lafo* term.

The *huni* is a small piece of cloth on to which oil was poured to rub on the pieces to make them run smoothly. A man may use the oil very sparingly for fear of making his piece too greasy, thus causing them to travel too easily and too far. This expression is applied to one who, afraid of over-doing the oil, has overdone his caution with the upshot that his piece has come short. Used of one who is cautious and sparing in the use of his material and has thereby failed in that at which he aimed.

582. **Olo faka-lafo-koa:** Deceit, device, after the manner of *lafo-koa;* allurement by strategem (Baker).

Lafo-koa is a game of *lafo* played for stakes. The players make remarks to each other to put their opponents off their game, though it is against the rules to do this to a man as he is actually about to throw. This "barracking" is common to all games of *lafo* but probably there would be more all round keenness where stakes were involved. As applied generally the idea of the expression seems to be that just as one may think of something clever to say to hamper an opponent's play, or perhaps think of some clever device to bring off a successful throw, so may he invent some ingenious method of accomplishing his purpose whatever it may be.

583. **Oua te ke mata-fala ua:** Don't be at two ends of the mat.

A *lafo* expression. In a game with two on each side the pair of opponents sitting together at each end of the mat adjust differences, discuss and decide which is the scoring piece. When the game is played by groups of five, one of each of these fives, namely the one called the *toekai* who throws last, performs the offices of umpire in consultation with the *toekai* of the opposing side who sits next to him. The *toekai* sit facing each other at the ends of the mat while the rest of the teams sit around the corner at the side. This phrase is a rebuke to a man who wishes to interfere in the consultations and decisions of the players at the opposite end of the mat. Generally, to mind one's own business.

584. **To to motua paanga:** Falling, falling large piece.

The reference is to the large piece, in the game of *lafo,* falling upon and sweeping from the mat the smaller pieces. One large piece may sweep from the mat several of the smaller pieces. One who is strong brushing aside all the opposition of even a number of puny adversaries.

585. **Va kaunahu:** Edge of *nahu* space.

The edge of the mat in *lafo* used to be raised by bolstering up with a bed of *nahu,* a sort of fern. The *kaunahu, nahu* edge, therefore, is the raised cushion along the side of the mat which skillful players are able to use with great effect. The space, interval, road, of the *nahu* edge is a difficult shot which a good player can bring off by using the raised sides of the mat. Used generally of that which is difficult but not impossible.

586. **Va puna:** Jumping distance.

A *lafo* expression indicating that the pieces of two opponents are close together but not touching, so that one player is able to throw a second piece and knock his opponent's piece off the mat, make it jump off the mat, without disturbing his own first piece. If this move is brought off successfully the man who makes it will have two pieces of his own in good positions, and will have put one of his opponent's pieces out of action. Proverbially it means that there is an obstacle ahead but it can be shifted.

HEU LUPE

The sport of *heu lupe,* pigeon catching, was carried out on a mound. Trained pigeons were used as decoys, and when the quarry approached near enough it was caught in a large net mounted on a pair of long handles hinged near the bottom end. The man who manipulated the net closed the mouth of it when the pigeon was inside by bringing the hinged handles together.

587. Ala i jia ala i kolonga: Skillful in *jia,* skillful in *kolonga.*

This expression originates in the sport of pigeon snaring. The mound where the snaring was actually carried out is called the *jia* and the place where the work (largely culinary) necessary for the comfort of the sportsmen was done is called the *kolonga.* This expression means literally a man whose energy and ability are equally conspicuous in either place, and is freely used of a good all-round man.

588. Fakalaa i jia melie: Enduring sun on lucky pigeon mound.

Although the principal times for the pigeon snaring are the morning and evening, yet one will put up with the inconveniences of the midday sun if the sport be good. So in any pursuit one will put up with inconveniences and hardships so long as his object is attained.

589. Fakalaa i jia tamaki: Enduring sun in bad pigeon-mound.

The reverse of No. 589; enduring hardship and inconvenience for what after all proves to be not worth the pains.

590. Faka-mui-manoa: At end of tethering cord.

The *manoa* is the cord with which the tame decoy pigeon was tied. However far the pigeon went it could always be traced along the cord, provided that the near end of the cord was still in hand. It is applied to a thing that has been out of sight for some time, but is at last traced up and found.

Another explanation given is that the decoy pigeon has reached its quarry without all the cord running out, there is still more to follow, and it is said to be applied to a conversation or other employment discontinued for the time, but "to be continued in our next." (See No. 591.)

591. Motu manoa: Separated (from) tethering cord.

The cord with which a decoy pigeon is tied has run out to its full length and been let go. Applied to a thing which is finished; there is no more to follow.

592. Koe fakanavau ke ha? To mark for what?

The *navau* is a distinguishing mark fixed to the body of an animal, particularly the mark tied to the leg of the tame decoy pigeon. This is used of marking what is obvious; what is the use of marking what is plain to everyone? It is also used as a very open-hearted and genial response to one who comes to make a request. What are you asking for? Anything that I have and you want, just take and welcome.

593. Kuku kaunaka: Grasp handle.

A phrase of the pigeon snaring, being an injunction to the men who handled nets to hold the handles firmly lest the birds escape. Like *"Pukepuke a fufula,"* "Seize the big pig," it is an exhortation to devote one's attention and energy to the task in hand.

594. Mounu vaoa: Decoy pigeon taken to the woods.

Applied to one who has relapsed into bad old habits, like the decoy bird who after all his taming and training has gone wild again.

BOXING, WRESTLING, CUDGEL PLAY

[These sports often formed part of important ceremonies and celebrations.]

595. Ta ji ta lahi ta atu pea ke tangi: Little one hits, big one hits, go on hitting, and you will cry.

The little one can cause very little pain to the big chap by his blows, but the big fellow can make himself felt by the little one. So if it comes to an exchange of blows between the big chap and the little chap it will end in tears for the little one.

This is a word of wisdom, advising the little fellow to be modestly cautious about whom he undertakes to fight.

596. Va feinofi: Striking distance.

Primarily a boxing phrase, particularly of the sport called *toutakao* in which a number of combatants participated, men choosing their opponents more or less at random. *Feinofi* means shaping at each other, challenging each other, and *va feinofi* is used of two men who are close enough to each other to spar. Thence simply "close."

597. Fetaaki a feiloaki: Cudgel play of men used to each other.

This indicates that each man gives a fine exhibition, as, being accustomed to the other's strokes and style, his own game has the precision that such experience always gives. The point that is emphasized is that both men fight like experts. (See Nos. 468 and 469.)

598. Ojioji palalafa: Coconut-leaf stem finished.

The coconut-leaf stem was used in practising for the club or singlesticks matches *(fetaaki)*. To finish the coconut-leaf stem, or to do one's utmost with the coconut-leaf stem, means to put one's whole strength and energy into this practice. The expression seems to be used particularly of team work, to do one's best for his team. These old contests were between teams though the combats were between individuals from either side.

599. Teu toka ka koe tue: I shall lie down, but the shouting.

This is an expression from the ring. The lying down indicated is the being thrown down in wrestling. To be overcome and even to sustain severe injury is a thing that can be easily endured, but the shouting of the onlookers is quite another thing. Therein lies the unendurable shame of defeat. Baker renders the phrase, "To yield to fate but to fear derision."

600. Toka a puka: Lying of pig.

An expression from wrestling, indicating that both wrestlers have fallen and that it is difficult to see who is getting the upper hand. The confused forms of the combatants would seem to be likened to a pig rolling on the ground. Used generally of an evenly contested match of any kind when it is hard to say who is the stronger.

601. Toka ki malae: Lying on (the) green, that is, on the green where such sports as boxing and wrestling are held.

This indicates one who has been defeated in a wrestling match, and has measured his length on the grass. In spite of his defeat there is to his credit that he had the courage to enter the contest and try.

602. Mafi to ki haa tuele: The explanation of this is forgotten by the present generation of Tongans, but the meaning given by Baker is: "To challenge when and where there is no prospect of an antagonist."

A literal translation of the first part seems to be: "Victory falling to *haa tuele,* but the difficulty is to place the *haa tuele. Haa* is the ordinary word for a tribe, clan, but it is used very widely of almost any group of people associated together according to different principles, such as similarity of occupation. *Tuele* may be the proper name of some tribe, or clan, perhaps Samoan, but a not improbable conjecture is that it is the Samoan word *tuele,* meaning to stand on the ground, and that the phrase indicates that victory is going to those who merely stand on the ground and have no opponents to contend with. This is consonant with the interpretation given by Baker. It seems to be a phrase belonging to sports such as boxing, wrestling, single-sticks.

VELO FA AND JIKA

[*Velo fa* is the sport of throwing a dart at a mark; *jika* is distance throwing with light darts.]

603. Tali fa: Receiving pandanus.

Although this translation is a literal rendering of the words it does not properly express the sense, which is rather that of making right with the pandanus. This is from the sport of *velo fa,* shooting at a mark consising of a piece of the trunk of the pandanus tree set up on end, the aim being to make the dart stand in the top of the pandanus stake. Sometimes a bunch of the fruit of the pandanus was hung up as the mark. In this sport the Tui Tonga, if he took part, threw last, and a man was stationed near the mark to catch the dart of this august chief and stick it into the mark. This man, and his duty, were both called *tali fa.* The expression is used of favoritism,—of securing success by extraneous assistance rather than one's own excellence.

604. **Holi fa:** Striving for pandanus.

This is from the game of *velo fa.* (See No. 603.) The phrase indicates a dart that has almost, but not quite, succeeded in sticking in the mark. It is used generally of a failure that is very near to success.

605. **Jii kae amo:** Short yet winning.

This is a word from the sport of *jika,* dart-throwing. In the long distance throwing contest the dart of the biggest chief taking part was frequently turned over length-wise if it were almost, but not quite, the best throw. This was adding a handicap of a dart's length to the chief's cast. The limit of this assistance to the chief was apparently three turns, three dart lengths. If with this handicap the chief was ahead he was reckoned the winner.

The expression is used proverbially of an undertaking which has succeeded, not by the unaided merit of its performance, but through extraneous help.

606. **Hange ha kaho halia:** Like a glancing reed.

This is from the sport of *jika,* in which the dart was thrown so as to glance on a piece of level ground, or sometimes on a small mound, and ricochet on to a further distance. He who threw furthest won. The reed is the dart. A well thrown dart went on with fresh energy after glancing, and so the expression is applied to a fleet-footed runner, and generally to a willing and energetic performer in any sport or labor.

FANIFO

[The fine sport of *fanifo,* surf-riding in which the skill of the Tongans, as of other Polynesian peoples, evoked the wondering admiration of early travellers, seems now to be rarely, if ever, practised in Tonga.]

607. **Auhia a motua fanifo:** Man carried away by the current (or waves) who is skillful in the sport of shooting the breakers.

For an unskilled person to be carried out is a matter of grave concern, but for the man thoroughly at home amongst the waves no anxiety need be felt. So of the affairs of life generally, we may see a man involved in difficulties, but knowing, and having confidence in his energy and ability, we have no misgiving but that he will successfully win through.

608. Fanifo kave papa: Surf-riding, borne by board.

The man who is not very skillful at the sport depends entirely on his board to get safely over the breakers, whereas to the real expert the board is a matter of indifference. Applied to the man who gets safely over his difficulties rather through assistance afforded him than by his own intrinsic merits.

609. Holo pe tuu he koe ngalu e faji: Keep places, for the wave will break.

An expression taken from the sport of riding the breakers *(fanifo)*. It may happen that the swimmers have to wait a considerable time for a suitable breaker, and that some of them will become impatient and begin to swim about or to divert themselves in some other way rather than watch attentively for a good wave; but the advice of the expert is to keep continually ready for the wave when it comes; only thus can one be sure of utilising opportunity when it does present itself. It is an exhortation to watchful patience.

MISCELLANEOUS

610. Fai mai e hele pulu ki he hele kalava: Snare of coconut husk brought to snare of fibre of the coconut leaf stem.

Of these two snares that made of the fibres taken from the stem of the leaf is tougher and stronger than that made of fibres from the husk of the ripe fruit. If these two sorts of cord were knotted together and a strain put on at the ends the weaker would break.

Applied to a man trying to get the better of one who is stronger or cleverer than himself.

611. Hange ha hapohapo tangamimi: Like catching a bladder.

The pig's bladder is frequently taken and blown up, thrown about and caught by children at play, but on account of its lightness it is apt to bounce from the hands and is hard to catch. Used of boats tossed about by the waves, and generally of that which is elusive and difficult to get a firm hold of.

612. Hange ha moli touhuhu: Like a stabbed shaddock.

Originates in a boys' game called *touhuhu*, stabbing. A shaddock was suspended by a cord at a convenient height above the ground and the players stood round armed with small sharp sticks. The shaddock was sent swinging round and the boys made jabs at it with their sticks. A point was scored whenever the shaddock was impaled on the sticks, each player counting his own points. The score ran from six to ten, that is, the player won who first pierced the fruit five times. The shaddock by this treatment was soon battered and war-worn. The phrase is applied especially to a much wounded warrior, and generally in the same way as we speak of a person or thing that is much scarred, war-worn.

613. Luki aka fai ki Fiji: Challenging Fiji to a kicking match.

Used of an immoderate boast or challenge. Fiji is a country far from Tonga, and its inhabitants are numerous. To challenge Fiji, therefore, is doubly an immoderate boast. To reach the scene of action is no mean task, and when the initial difficulty of navigation is overcome one's hands will be more than full with so many antagonists.

614. Matakai ngalo oua e kau ai: Don't count a forgotten *matakai.*

This refers primarily to the game of *fiji,* or flipping, which consists in flipping one by one a bundle of small light sticks from the bottom of an inverted basket, or some such stand, across which they are laid. The *matakai* in this instance are the sticks. When a player has successfully flipped all the sticks (not so easy by the way as it looks) he says, "no forgotten sticks are to count," thus saving himself from all penalty should any be found to have dropped down and been overlooked. The expression comes to be a sort of general forestalling of the effects of any sins of omission

615. Tua ka matakai pipiki: A chap to stick to the matakai.

The *matakai* is the object with which the game of *liaki,* and other games, were played. This phrase refers to the game of *liaki,* in which one player held a small object such as an orange seed between two fingers, clenching the fist. The man who held the *matakai* put his clenched fists out in front of him while his opponent, without touching him, tried to make him laugh or squirm and drop the *matakai.* A man who was invulnerable to all the attacks made on his nerves or risibility was able to keep his fists tight shut and hold the *matakai.* Applied to one who is adept at sticking to things, who keeps a firm hold on his property, and also applied to one who keeps his own counsel.

DANCING

616. Haka i langi tau: Dancing to suitable music.

Where the music is good and rhythmic the dancing will be easy and attractive, a fit vehicle of rejoicing and calculated to cause pleasure to the beholders. Strictly the word *langi* seems to denote rather the line or group of singers than the music itself. This phrase, written as one word, is freely used in the sense of joy, rejoicing.

617. Malanga i faiva: Getting up during dance.

The word *faiva* is not confined to dances but is applied also to games and sports and generally to any employment requiring skill. The idea of this phrase is that of a man who should go, say, to a dance, not as a performer but simply as a spectator; but who during the dance is moved to get up and join in, though he has not practised for the occasion. He stands there in all his unpractised awkwardness among those who have perfected themselves in the movements. A useful warning for extemporaneous speakers.

618. Nofo a mama kae kailao e fakafaanga: Men doing nothing while the gods dance.

More strictly *fakafaanga* seems to mean the material objects, including priests, in which the gods appeared. The phrase indicates that it is useless for men to let the gods have the entertainment of their dances while they themselves do nothing. Men are unable to share the enjoyment of the denizens of the unseen world, and so they must get to work and make their own fun.

619. Taka i lalo hakanga: Living below the dancing place, that is, in close proximity to it.

One who lives in a place where dances are constantly learned and performed has exceptional opportunities for becoming proficient. So the expression is used of one who enjoys great facilities for acquiring some art, knowledge, or other benefit, material, mental or spiritual.

UNCLASSIFIED PROVERBS

620. Afi jii tupu ai e afi lahi: Small fire, there springs from it the great fire.

A warning of the sort common in so many languages and literatures against the unwisdom of neglecting evil in its small beginnings. It is possible to use it also as an expression of the great good works that spring from humble beginnings.

621. Alualu i mala tau ki monu: Going along in misfortune, reaching good fortune.

It is used of one who, after being long involved in ill luck, at length experiences a change of fortune and has prosperity. As a matter of actual present day experience one frequently hears it applied by the natives to their having been so long involved in the darkness of heathenism and having in these latter times come out into the light of Christianity.

It is said that *Mala* (Curse, Misfortune), and *Monu* (Blessing, Good Fortune), are two places, and that one who has reached Mala finds it very difficult to return and get to Monu.

622. Alualu i monu tau ki mala: This is the reverse of No. 621.

Going along in good fortune, reaching misfortune, and is used of the change from prosperity to adversity.

623. Fai mai ete meimei tangi:

We have not succeeded in finding a contemporary Tongan able to explain this. All the words are in common use, and would seem to have some such meaning as "present (a case) almost weeping," as of one making a request with such earnestness that he is on the point of tears; or, taking the word *tangi* in the sense of "appeal, make a request," instead of that of "crying, weeping," we might render as, "I am come with almost a request," in some uncertainty as to whether to make the request or not. Baker, however, gives the somewhat cryptic forensic phrase, "Generally repeated; used when two persons report their cases, and the one hearing is alike affected by both." (An English and Tongan Vocabulary, p. 207.)

624. **Fe-toutou-mo-liliu-aki:** "To wander to and fro" (Baker). Constantly changing or going to and fro.

Of the different elements of this compound *toutou* is usually employed today as an adverb meaning constantly, repeatedly. Baker gives "alternate" as another meaning, and also has it as a verb, to reciprocate. *Mo* is the conjunction and *liliu* means to change; *fe-* and *-aki* are regularly used as prefix and suffix to make verbs reciprocal or reflexive. The whole word therefore seems to denote a very high degree of instability in opinion or conduct.

625. **Hange ha mumu hulu:** Like trying to get warm at a fire of dried leaves; a fire that flares up and quickly dies down.

Generally of that which makes a great show but is not solid and enduring.

626. **Jio kalo jio:** Seeing, warning off seeing.

The seeing indicated is that of looking after one's own interests. A man, in order to get something for himself, goes to a place where he has no particular right to be and tries to drive off another who is doing the same thing.

627. **Maka fetoliaki:** Chipping rock with rock.

Baker translates the phrase, "To be of one mind; to use freely from each other's stores." To be of mutual benefit. It is explained as meaning literally to chip off a piece from one stone with another and then to take that piece and use it to chip a fragment from a third rock, and so on. Thus to pass a benefit on from one to another. This was illustrated by the coming of Christianity, brought by Europeans to Tonga, and taken by Tongans to Samoa and Fiji, and by Fijians to the Solomon Islands.

628. **Makaka noa:** Hard to no purpose.

Noa, here translated "to no purpose" is a very largely used word, and extremely difficult to translate by an exact English equivalent. It is used in all sorts of contexts with such senses as purposeless, valueless, unreliable, being where one has no business to be, acting as one should not. In the phrase above the idea is that of a thing being hard where it should be pliable and soft. The phrase may be applied to that whose conduct is unexpected, not of a piece with the general behavior of the class of things to which it belongs. For example, the outlandish behavior of the goat has won this epithet for it. It may be used of one who goes with great vim into some job that is not really his concern.

629. Nei ako maile e kakau:

This division of the words is merely conjectural, and we have not been able to find a translation or explanation. Baker according to his custom prints the phrase as one word, thus, *Neiakomaileekakau,* and explains it as, "A phrase meaning, do it shall I be the only sufferer." (An English and Tongan and Tongan and English Vocabulary, p. 209.) Taking the word *maile* in the sense, found in Samoa but not in Tonga, of a dog, the expression may possibly mean, Is this going to teach the dog to swim? Although one may imagine circumstances in which such a meaning as this might come to have the sense indicated by Baker, yet in the absence of all legend accounting for the origin of the phrase it is impossible to judge of the value of any conjecture.

630. Oku pule pe a seleselega: Chance rules.

The unexpected happens; we are in the hands of fate.

631. Pikopiko iku mai: Winding about, arriving back at the end.

Used of one who turns aside from the road, and after much wandering gets back again at last. Baker gives this expression as applicable to a thing which after being taken from place to place returns at last to the original owner.

632. Sosaa a tangata puli: Anxiety of man (who is) hid.

This indicates one who makes occasional short appearances among others with whom he cannot agree; not so much with whom he has actual quarrels, but between whom and himself there is not agreement as to the proper way of going about things. His presence is a disturbing factor in their lives but they tolerate him, knowing that he will soon go away again, when they may pursue their own course undisturbed.

633. Taimalie a tangata vale: Opportunity of foolish man.

This has its obvious meaning of opportunity thrown away on one who has not the skill or energy to turn it to advantage.

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Tongan Astronomy and Calendar

By E. E. V. Collocott

From the exceedingly fragmentary and obscure accounts it appears that the Tongans possess but the vaguest notions of the heavens and of the relations of the sky to stars and sun and moon. They evidently thought of a number of skies, one above the other. One informant expressed the opinion that the number of skies was as great as one hundred. He also suggested a connection between the skies and the great burial vaults at Mua and elsewhere, and it is worthy of note that sky and vault are called by the same name, *langi*. The stars are said to be in the highest sky.

So far as I have been able to discover, the study of astronomy was treated by the Tongans as a branch of navigation. Certain it is that these bold and skilful mariners were keen observers of the heavens and that no small part of the equipment of the old sea captains was the ability, based rather on experience and judgment than on rules, to determine when to shift from one star or constellation and to set the course by another group.

Practically the whole of the available star lore of the Tongans is embraced in sailing directions written by the late Tukuaho, a high chief who was Premier of Tonga about thirty years ago. Tukuaho, fortunately, was an intelligent diarist who carefully wrote down what he heard. His account, copied with permission of his son Tungi, Consort of Her Majesty Queen of Tonga, has been followed in the preparation of this paper.

Few if any living Tongans are able to point to and name more than a very small proportion of the stars, and only in rare instances have I been able to identify the stars named. This rapid decay of the old astronomy is doubtless due to the universal use of the mariner's compass. Star lore was preserved by the old navigators, but there is no longer need to rely upon it.

DIVISIONS OF THE HEAVENS

The Tongan mariner divided the heavens into three areas or zones, called *fanakenga,* a word which apparently means risings (compare Samoan *fana'e,* rising of tide and moon; Maori, *whanake,* to move onwards or upwards). These three divisions are named respectively: Fakatonga (southward), the southern zone; Faka-loto-langi (mid-sky), the mid-sky zone; Faka-tokelau (northward), the northern zone. Guide stars were observed astern as well as ahead and the boat was kept in line with them. As the stars or constellations were probably used when at or near their meridians, different constellations were utilized at different seasons of the year. In the following list the stars seem to be arranged in the order in which they rise.

STARS OF THE SOUTHERN ZONE

1. **Houma-utu,** mentioned by Tukuaho as used at a time which corresponds to about March.
2. **Halia-toloa,** four stars (compare Samoan, *Saliatoloa,* the name of a certain star[1]).
3. **Toloa,** four stars.
4. **Lua-a-tangata,** two stars (compare Samoan, *Luatangata,* the name of two stars, Castor and Pollux).
5. **Moa-a-mahe,** one star (compare Samoan, *Moa,* the name of a moon in the wet season).

This completes the southern zone as given by Tukuaho. Of these stars and constellations Toloa is the Southern Cross. Toloa means a wild duck, and Tongan imagination pictures the Cross as a duck whose head is gamma and tail alpha, the wings being beta and delta. The wing delta being dimmer than its fellow is said to have been injured by a stone thrown by the Two Men, Ongo Tangata, alpha and beta Centauri. The stone itself, *Maka,* is epsilon in the Cross.

Although Tongan confirmation is lacking, I think it probable that the Two Men, which are missing from Tukuaho's list, are to be identified with Lua-a-tangata, sometimes called Lua-ae-tangata. In its present form this name would mean man's vomit, but probably an older and more correct form is Lua-tangata, or Lua'i-tangata, two men. Lua, two, is not now found as a common numeral in Tongan, the ordinary form being ua, but *lua* is the numeral two in Samoan, and is found in Tongan in composition. Both Brown[2] and Pratt[3] give Lua-tangata as the Samoan name for Castor and Pollux, with Filo and Mea as the individual names of the two stars, but the presence of Lua-a-tangata in the southern zone and in close proximity to the Southern Cross in the Tongan list is against this identification for Tonga.

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[1] Pratt, George, Grammar and dictionary of the Samoan language, 4th ed., Samoa, 1911.

Other names for stars in the southern division are Tuutanga-ufi (piece of yam), and Mamangi Halahu, both of which appear to be variants for stars already mentioned, possibly for alpha Centauri, or according to other information for Moa-a-mahe. Tuutanga-ufi is the name used by the people of Ula, the chief sailor of the Tui Kanokupolu. Halahu is the name of a place in the high island of Eua near Tongatabu, where the species of yam called *mamangi* is supposed to flourish with exceptional luxuriance. This star was used in sailing from Fiji to Tonga.

Still another name for Mamangi Halahu is Mau-kuo-mau, an expression meaning got (arrived at) when clear, and used of a person who arrives at a kava party when the beverage has been strained and is clean and ready for drinking. The people of the Haapai chief Tuita are said to use this name for the star.

The dark patch of sky near the left-hand end of the Southern Cross is called Humu, and is brought into close association with the Southern Cross, as for example in the verse, which in the absence of legend is not remarkably intelligible:

Humu moe Toloa	Humu and Toloa
To hono fuji pea vaoa;	Plant their plantain and overgrown with bush;
Pea lele mai kuli Fiji,	And Fiji dog runs hither,
Tali fanaia, hala he vae, tau he ate.	His reception is being shot, missed in the leg, hit in the liver.

Humu is the name of a fish. The Samoan word *sumu* is the name of fishes of the genus Ballistes, and also the name of a cluster of stars. Samoan legend states that the *sumu* (fish) and *toloa* (duck) were taken up to heaven and became signs.[4] Maafu-lele (running fire) and Maafu-toka (lying, stationary fire) are the names of two bright patches in the southern sky, either of nebulae, or, according to other information, portions of the Milky Way. Baker[5] applies these names to the small and great Magellanic clouds respectively. The Milky Way is called Kaniva (compare Samoan, *Aniva*).

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[2] Brown, George, Melanesians and Polynesians, p. 348, London, 1910.
[3] Op. cit.

STARS OF THE MID-SKY ZONE

1. **Faniu,** a single star.
2. **Majiji,**[6] a single star.
3. **Moenga-manu, or Mohenga-manu** (sleeping place of a bird, or animal), a thick cluster of stars.
4. **Mataliki,** the Pleiades—in all probability.
5. **Matamemea,** a single star. This word appears to mean ruddy and is given by Pratt as the Samoan name of Mars.
6. **Tuinga–lama,** three stars. This word, meaning a torch of candlenuts, appears to be Samoan rather than Tongan and is given both by Brown[7] and Pratt[8] as the Samoan name for an unidentified star.
7. **Faipa,** three stars.
8. **Alotolu,** three stars. Alotolu means a three-oared boat, or three in a boat, and is the name of a portion of the constellation of Orion. Tongan tradition asserts that Alotolu is the boat in which Hina went with her father, Maungakoloa, and her mother, Tamatangikai, in search of Hina's pet shark, which had escaped when the sea overflowed the pool where it was kept. Hina and her parents, as well as her two brothers, Ngatai and Fanua, were turned into various rocks and beaches in Vavau. Closely associated with Alotolu in Tonga is Tuinga-ika (string of fish), which is missing from Tukuaho's list. Both Tuinga-ika and Alotolu are parts of Orion, and it is possible that Tuinga-lama, which seems to be better known in Samoa than in Tonga, is identical with Tuinga-ika.
9. **Tolonga-Maui** (throwing of Maui ?), one star.
10. **Takulua-Alofi and Takulua-Tua-fanua,** two large stars which rise one in front (alofi) of Akana and the other at the back (tua) of the island.

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[4] Pratt, op. cit. See the word *sumu.*

[5] Baker, Rev. S. W., An English and Tongan and Tongan and English vocabulary, Auckland, 1897.

[6] Throughout this paper I have adhered to the practice of writing *j* before *i*. In earlier Tongan the syllable *ji* had much the sound of English *tchi,* but is now indistinguishable from *si.*

[7] Brown, op. cit., p. 349.

[8] Pratt, op. cit.

The Akana mentioned is probably the Aana of Samoa. Pratt and Brown give Taulualofi and Tauluatuafanua as Samoan star names. Brown[9] suggests that the names mean the pair Lofi and Tuafanua, or that Lofi and Tuafanua were joined together as the Siamese twins. If this is the correct explanation there is doubtless some forgotten legend connected with the names. The Tongan forms suggest the possibility that the names are of topographical origin and refer to stars which rise respectively at the front and at the back of Aana, though in that case two pairs of stars, or two double stars rather than two single stars, would seem to be indicated.

STARS OF THE NORTHERN ZONE

1. **Ao-o-Uvea,** a circular constellation. The word means circlet of Uvea, and the cluster is said to owe its name to the fact that the mariner does not use it as a guide until it is standing like a circlet around Uvea.
2. **Kapakau-o-Tafahi,** eight stars. The name means, wing of Tafahi (Boscawen Island). This cluster is said to be like a hen brooding over Tafahi with wings appearing on either side. It has been identified as Coma Berenices, but the identification is doubtful, as the honor is shared with the constellation Fatanalua.
3. **Tupa-a-Vaitupu,** three stars. This group is named after the crab (*tupa*), one star being called the Big Claw (Vae Lahi), and another the Little Claw (Vae Jii).
4. **Fatanalua,** eight stars. The word seems to mean double bier. The eight stars are divided into two groups of four, called respectively Upper Bier (Fata Olunga) and Lower Bier (Fata Lalo). This constellation also has been identified with Coma Berenices.
5. **Tuula-lupe,** five stars. The word means pigeon roost. Sailing directions, which are rather obscure, state that this constellation must not be used to steer by till it stands straight like a pigeon perch, which consists of a vertical upright with crosspiece at the top. In Samoa the same word is used as a star name.
6. **Kaukupenga,** twelve stars. This constellation is said to stand round like a net (*kupenga*), possibly the pigeon snaring net. It may be the Corona Borealis, though there is no Tongan identification to support this supposition.
7. **Telengehe,** a single large star (compare Samoan, *Telengese*).
8. **Takelo,** two stars, so named from their yellow or ruddy tinge (*kelo*). Pratt gives *taelo* as the Samoan name of a moon in the wet season.

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[9] Brown, op. cit., p. 349.

The stars listed for the three sky zones are arranged in the order given in Tukuaho's diary. I am indebted to Mr. E. W. Gifford for the following sailing directions given by the chief Maatu of Keppel Island, which lies far north of the main part of the Tongan group:

> In sailing south to Tongatabu, steer by Haliatoloa, Lua-ae-tangata, and Faipa.
>
> In sailing north to Keppel Island, steer by Faipa, Aloua (two-oared boat), Telengehe, Fatanalua, Tupa, Tuutangaufi, and Vai-utu-ki-tua (water carried outside) of which a variant is Utufi-ki-tua (carried outside).

It will be noted that most of the stars named by Maatu are included among those mentioned on the preceding pages but that Maatu's list does not follow the same order as the list arranged by Tukuaho. No living Tongan known to me is able to point out the various stars named, but I am of the opinion that for a conjectural reconstruction of the system the order given by Tukuaho can be followed with confidence.

THE SUN

When the sun sets it is said by the Tongans to go down to Lolofonua, the Underworld, the abode of the Maui, whence it issues at its rising, but I have been able to find no explanation of the sun's daily journey nor of its path between the Tropics. If native accounts existed of these phenomena they are entirely or almost forgotten. One informant said he had heard a story of the reason of the sun's setting but had forgotten it.

It is said that someone named Loau, who lived long before the Loau of Haamea in Tongatabu so famous in Tongan tradition, traveled to Samoa and thence to Tonga in search of the sun. But beyond this bare mention I have heard nothing of this personage and his quest.

A Tongan tradition connects Jinilau with the sun—Jinilau being said to be the son of the sun and a mortal woman. Throughout Polynesia there is an association of Jinilau with Hina, and the Tongan tradition states that Hina was married to Jinilau. Clouds on the eastern horizon at sunrise are said to be placed there to ensure privacy for the sun and Jinilau as they talk together.

THE MOON

There seems great probability that the theory which connects Hina with the moon, *mahina,* is correct. Tongan tradition associates Hina with the shark. A myth from Eueiki in Tonga asserts that Hina was an exceedingly beautiful girl, the daughter of the chief of Eueiki, and that one day while sporting in the breakers she was swallowed by a Samoan deity, who assumed the shape of a shark for the purpose. Possibly this myth is to be referred to the monthly disappearances of the moon.

The association of Hina with the Maui is also common throughout Polynesia. In Tongan myth a maiden Sinailele, living in Fiji, becomes pregnant by stepping over the bones of Maui Atalanga and Maui Kijikiji, and thereby becomes the mother of Tui Motuliki.[10] Sinailele seems to be a Fijian modification of Hina, and the connection of Hina with the Maui may be a connection of the moon with the Underworld, parallel with the association of the sun with the Underworld.

There is a place at Matoto in Vavau which affords a fine outlook over the ocean and is famous as a spot at which to see the moon rise. This locality is named Mata-mahina-hopoanga, or Matanga-mahina-hopo, place of seeing moon rise. When parties repair thither they must make no noise and kindle no fire till the moon is fully above the horizon. As the moon appears over the ocean as though she were floating up from the depths of the sea, she is said to *kakau mai,* swim hither. When she is clear of the horizon and the onlookers are free of the tabu on noise it seems to be not unusual to raise cries of joy. The information I have been able to obtain about this custom is very scanty, but it is possible that details, if one could obtain them, would be full of interest.

There is a couplet referring to this moon-viewing site,

Fine taumelo hake ki Matoto	Harbinger woman goes up to Matoto
Ko ene fie mamata he mahina hopo.	Because she wants to see the moon rise.

The moon, also the sun, in eclipse is termed by the Tongans *mate,* dead. In ancient times this phenomenon seems to have attracted little attention. Likewise among modern Tongans eclipses do not excite very great awe, but there is some disposition to regard them as ominous, especially an eclipse of the moon in which the shadowed planet has a ruddy tinge. It is not unlikely that this modern attribution of ominousness has arisen from certain expressions in the Bible, especially as interpreted by those sects that emphatically teach the existence of occult relations between such phenomena and human history.

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[10] Folk-Lore, vol. 32, No. 1, pp. 53 ff., 1921.

THE TONGAN CALENDAR

LONG PERIODS OF TIME

The word *tau*, used in modern Tonga as the equivalent of the English year, means also the yam crop, and although it is possible that before the advent of Europeans this word signified the annual circuit of the seasons, there can be little doubt that primarily it refers to the yam.

There seems to have been no system whereby numbers of years were counted. The practice, still prevalent enough, was to reckon long periods by comparison of notable incidents, of generation with generation or of man with man. As a countryman may say that a certain event happened the year that the red cow died, or just before the drought or the flood, so the Tongan reckoned by such things as war, festival, drought, and hurricane. It is not uncommon to find personal names commemorating the fact that their bearers entered life contemporaneously with the occurrence of some outstanding event. The Tongan of today, like the European who employs such methods, proceeds to translate his date when located into calendar years and months.

The life of man is frequently used as a standard. In answer to the question when such a thing happened one may get such replies as "I was a child running about at the time," "I was a young man," "My mother told him that it occurred just before I was born." In the same way people speak of their ages. One may say that he is of the same generation (*toutangata*) as another man; a very aged man may be spoken of as having outlived all his contemporaries. A number of elderly people and even some children do not know their ages, but the proportion is probably less in this generation than in the last. The habit of counting years is becoming common. Government requirements of registration and the practice of entering the ages of children in school rolls lead naturally to this result.

The life of the individual is divided into a number of periods which give a rough indication of age. The child is first *huhu* (at the breast), then *mavae* (weaned). This latter word however does not give a very close approximation to a child's age as understood by a European, as many children continue to suck the breast, though eating other food, for two years or more. Other words in the stages of life are, *tateka* (crawling about), *totuu* (commencing to stand), *akoako haele* (learning to walk), *haele* (walking), *lele holo* (running about), *fangafanga* (hair cut short on the top but left at the sides)—a custom that has largely fallen into disuse.

From childhood on different words are used of men and women. A general word for boy is *tamajii*. As he grows up he is *talavou jii* (little, young, young man), *talavou* (young man), *tangata* (man)—a word of very wide application—*fatu tangata* (middle-aged man), *fatu tangata motua* (late middle-aged man), *vaivai* (old, literally weak), *veetolu* (three-legged, that is supporting himself on his staff), *auau* (going down, failing). So too a man may be described as *motua aupito* (very old), or *unu* (shedding skin).

Words descriptive of the growing girl and woman are *taahine* (general word for girl), *huhu tutuu* (breast forming), *finemui jii* (little, young, young woman), *fefine* (general word for woman), *fatu fefine* (middle-aged woman), and so on as for men with the necessary alterations of *tangata* (man) to *fefine* (woman).

A man is frequently called *motua* and a woman *finemotua*. These words properly indicate a man who has begotten and a woman who has borne children.

By the use of such words it is possible to locate comparatively recent events; for example, a man may say that such a war was fought when his father was a young man. More remote occurrences may be reckoned by generations. For example, "It is three generations since this happened" or "It occurred when my father's father was a child."

A general word for long ago, ancient times, is *onoaho,* as *onoponi* is used for recent time, the present age. There are several expressions for remote antiquity, as, *Hau o Momo* (when Momo was king), *Hau o Tuitatui* (when Tuitatui was king), *Hau o Muni Matamahae* (when Muni of the Torn Eye was king), *Hau o Motuku Veevalu* (when Motuku Veevalu, literally Eight-legged, was king). There are of course other words meaning uncountable, long enduring, which may be used to express the same idea of remotest antiquity.

SEASONS AND MONTHS

The Tongan year is said to have begun at about the same time as the Christian year, though no satisfactory explanation is given. Gill[11] states that the Mangaians begin their year about the middle of December, the point of departure being marked by the appearance of the Pleiades on the eastern horizon just after sunset. This or some similar astronomical phenomenon may possibly have determined the beginning of the Tongan year.

The two broad divisions of the year, in one of which the days and nights are cooler than in the other, were recognized and used to classify seasons. Close observation of the habits of plants and of animals provided a basis for more exact division. The times when certain trees cast their leaves, flowered, or bore fruit were utilized in making the calendar, as were also the periods when particular fish appeared. The greatest importance attaches to the various stages of the growth of the yam. A large part of the nomenclature of the moons is based on seasonal changes observed in this plant.

The normal year consisted of twelve months, though some years had thirteen. The nomenclature is largely agricultural, but there seems no reason to doubt the statement that the names were applied to the moons. The months and the commonly received explanations of their names are as follows:

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[11] Gill, W. W., Myths and songs from the South Pacific, p. 317, London, 1876.

1. **Liha-mua:** Early nit, December-January. This is the time when the first planted yams are forming roots. At this stage of growth little protuberances or roughnesses, like nits, appear on the heads of the roots. The name is also explained in a more general way. Many fish spawn at this time, and many trees show tiny fruits. A word for little things is nitlike, *ngalihaliha*, and the month is said to be so called because many things are "nitlike" at this period.
2. **Liha-mui:** Late nit. January-February. All the yams, late as well as early, show the little nitlike protuberances.
3. **Vai-mua:** Early rain (water). February-March. The first rainy month.
4. **Vai-mui:** Late rain. March-April. The second rainy month.
5. **Fakaafu–moui:** Putting forth living shoots. April-May. This is a time of vigorous growth with healthy suckers and shoots appearing on many plants. The word *afu* applies especially to the suckers of the *hiapo* (paper mulberry), but is also used more widely. The *fuji* (plantain) and *fau* (*Hibiscus tiliaceus*) should now be planted.
6. **Fakaafu-mate:** Dead, dying, suckers or shoots. May-June. Suckers are now not so vigorous, and dead tops of the yams appear.
7. **Hilinga-kelekele:** Laying earth, that is, either laying of earth or laying on earth. June-July. This is the month in which to start digging the yams. One explanation of the meaning of the name is that the harvested yams with earth adhering to them were laid on platforms constructed in suitable places, as under a tree or in a house, and that the name owes its origin to the fact that the adhering earth was laid down with the yams. Another explanation is that the yams were taken up and laid on the surface of the ground. The two interpretations are not inconsistent, for yams laid on a platform might still be said to be put on the ground. The name itself does not convey a precsie meaning.
8. **Hilinga-meaa:** Laying *meaa*. July-August. This is the time to dig and store the remaining yams. These late yams are the biggest, and a portion of the garden is reserved for the special sorts of yam which grow to the largest size. The literal meaning of *meaa* in this place is doubtful. An explanation connects the word with *umea* (clay), and is to the effect that the big yams grow down into the clay which adheres to the roots when dug; but this interpretation is more than doubtful.
9. **Aoao:** August-September. The literal meaning of *Aoao* is obscure; a derivation for the name has been suggested which connects it with *hau-aoa*, used of rotting yam seed. The time for cutting yam for seed is now over, and it is said that if seed be cut in this month a considerable proportion of it will rot.
10. **Fuufuunekinanga:** Full leafiness. September-October. The yams, which have been planted about June and July, are now in full leaf.
11. **Ulu-enga:** Yellow head. October-November. This name is referred both to sea and land. Several sorts of fish are at a stage in their

growth when their heads are yellow under the scales. Ashore this is a time of scarcity, whence the proverb, *Ka ai ha ofa tatali ki Uluenga.* If there is any kindness (gift) wait till Uluenga, when presents of food will be most useful. When yams are dug a small piece of the root is sometimes thrown back into the hole. These pieces grow into yams, which though small are deep in the ground on account of the manner of their planting. During the time of scarcity people search for these little yams, and in bending down to throw the soil out of the deep holes they are likely to make themselves yellow-headed.

12. **Tanu-manga:** Throwing soil on branch, fork. November-December. A growing yam is likely to project slightly above the ground, and frequently a small yam grows down from the same stem thus making a branch or fork on the head of the root. In this month if the head of a yam appears forked (*manga*), the gardener banks it over with soil (*tanu*).

With Tanumanga the year normally ends. If, however, observation of the yam and other plants and of fishes at the next new moon fails to discover the appearances proper to the month with which the year begins, Lihamua, another month is intercalated.

13. **Ooa-ki-fangongo:** Using a coconut-shell as basket. *Ooa* is said to be a reduplicated form of *oa*, one sort of basket; *fangongo* is an empty coconut-shell cut open and used as a receptacle for small things. This is a time of scarcity, and the idea is that one needs but a small receptacle in which to place his food.

NIGHTS OF THE MONTH

With the Tongans, as with other Polynesians, it is habitual to count by nights rather than by days. Where the English speaker says "five days after" the Tongan says "five nights after." An intelligent Tongan suggests as a reason that his people treat the hours of daylight and of the succeeding darkness as one day and that in reckoning the closing portion of the day is considered.

The division of the month was based on the phases of the moon, and the days or nights were counted within the month, several of the nights having special names. Expressed perhaps in a better way, there were special names for the moon in several of her phases. The fisherman has strong reasons for close observance of the moon, as some days are *aho ika,* fish days, favorable for the catching of certain sorts of fish. These fish days evidently vary with different localities and for different species of fish.

It is asserted that the appearance of the moon in a looking-glass, probably a pool of water in former days, indicates the night of the month. The theory is that when the moon is thus viewed she does not appear single, but behind the image of the moon itself there is a reflection or shadow, giving the image of another moon. Sometimes one, sometimes more of these reflections appear, and according to the number of moons showing in the glass one may know what night of the month it is. Nights are named *faka-ua,* two-wise, *faka-tolu,* three-wise, and so on. On a two-wise night two moons appear in the glass, on a three-wise night three moons, and four-wise, five-wise, six-wise, seven-wise, and eight-wise nights appear to be recognized.

When the moon is looked at in a glass these subsidiary images certainly do appear, in varying number, but the appearance is affected by the quality of the glass and by the way in which it is held. Personal trial has yielded very unsatisfactory results, and Tongans who explain this method of reckoning nights do not seem very sure of its application.

In listing the Tongan nights it is impossible to be quite certain of some details, as excellent informants vary slightly in their accounts. One man, for instance, begins his count of the nights from that called *aho oe toutai,* sailor's day; another regards this as the second night of the month. It is not certain how far the "two-wise, three-wise" system of reckoning extended, either in an ascending series of the waxing moon or in a descending series of the waning moon, but it does not seem to have gone beyond eight or possibly nine. The words *aho,* day, or *po,* night, are freely interchangeable. But while there may be errors in detail the main outlines of the system are clear.

Po ae faahikehe: Night of the spirit. This is a night on which the moon is not visible to men; she is still below the horizon, and seen only by the gods. It is said that the horizon glows for a considerable time after sunset on this day. This is the shining of the yet invisible moon. This night may be considered either as the first of the month or as a spirit's night lying loose between months and left out of the count of human nights. I am unable to determine whether or not it should be counted as the first, but on the whole think it best to start with the next night.

1. **Po ae toutai:** Sailor's night. The moon is still invisible to landsmen but seen by those who are at sea.

2. **Faka-ua:** Two-wise, and so on to the eighth, *faka-valu,* to which a special name seems to have been applied, *punifanga* (shutting the circle formed by the brow and top of the head). The moon is now shaped like the front of the top of the human face and head. This name may have been applied to the following night also.
10. **Fuofua–vale:** Incomplete—the moon almost full.
11. **Mahina katoa:** All moon, that is, full moon.
12. **Fe-aho-aki:** Caught between two days. When the sun has set the moon has already appeared above the horizon, and when the sun rises on the following morning the moon is still in the sky.
13. **Uluaki ahoia:** First "caught by daylight," "out all night." If one stays up all night and is still up at sunrise he is said to be *ahoia,* "day-ed." So on this night the moon is still up when the sun rises.

Then follow second, third, and so on *ahoia* nights, when the moon is caught in the sky by the rising sun, but the interval between sunset and moonrise gradually gets longer, till at last there is a night when the moon does not appear at all but is *mate,* dead. This night is the end of the month and immediately precedes Po ae faahikehe, night of the spirit.

In counting the waning moons a nomenclature is employed similar to that used in reckoning the waxing moon, but in the reverse direction, *faka-valu,* eight-wise, *faka-fitu,* seven-wise, on down to *faka-ua,* two-wise which immediately precedes the night on which the moon is dead. This nomenclature seems to run parallel with the reckoning of the *ahoia* nights for a portion of the waning moon.

Ma-tofi, which means sliced *ma* (a food made by burying and fermenting breadfruit or plantain), is a name applied to the waning moon on the second *ahoia* night, when it presents the appearance of a large lump of this food with a piece sliced off the side. A European parallel would be a cheese with a piece cut off one side.

Kalipa is used to describe the moon when rather less than half and on the few succeeding nights, starting from about the time when the waning moon is *faka-valu,* eight-wise.

One informant applied the words Kalipa, Ma-tofi, and Fuofua-vale (noted above of the waxing and almost full moon) indifferently to the waxing and waning moon.

Lekeleka-mate, almost dead (?), is applied to the moon as it appears on the few nights shortly before its disappearance at the end of the month.

DIVISIONS OF NIGHT AND DAY

Following are a number of terms descriptive of various periods of the night and day, forming a more or less rough and ready time system. Starting from sunset and advancing through the night and the succeeding day these terms are:

1. **To ae laa:** Sunset.
2. **Feiloilongaki:** Recognizing. There is still sufficient light for people to recognize each other at a considerable distance.
3. **Uuli-kelekele:** Dark earth. It is now a little darker, and the face of the earth is begining to appear black.
4. **Femauaki ae pouli:** Dark obtaining everywhere. The darkness is enveloping all things.
5. **Tu mama:** Lamp lighting. Doubt is expressed as to whether or not this is ancient, though the Tongans employed artificial lighting before the coming of Europeans.
6. **Ha ae otu kaveinga:** The ranks of the constellations appear.
7. **Kau pouli:** Darkness bodied forth, black night.
8. **Tuua-po:** Night standing (?). Frequently with the addition of *malie,* exact, Tuua-po malie. The middle of the night.
9. **Vale po:** Night of no account (literally); indicates the same period of far-advanced night as Tuua-pomalie. This term relates perhaps primarily to dances and games, indicating that the night is so far spent that the main part of the amusements is over and the chief spectators and actors gone. What remains is of no account, the unconsidered amusement of such as choose to prolong the entertainment. This explanation though offered by a very intelligent Tongan seems very doubtful.
10. **Mafuli ae Kaniva:** The Milky Way turned. The Milky Way has turned so far that it is pointing to the east where the sun will soon rise.
11. **Moa mua:** First cock. Earliest cock crow, probably considerably earlier in Tonga than in higher latitudes.
12. **Tataki aho:** Leading in day.
13. **Fakaholo-fononga** or **Fakahala-fononga:** Making journey advance. This indicates the appearance of a star which is known to rise not long before dawn. Its appearance cheers travelers with the promise of approaching day.
14. **Moa mui:** Later cock (crow).
15. **Fetuu Aho:** Day star. The name is applied to Venus during her early morning appearances more than to any other star, but may indicate any bright star whose rising closely precedes the dawn.
16. **Ata a puaka:** Shadow of pig. This phrase is applied to much the same time as that marked by the appearance of the day star. The

idea is said to be that this is the time when the pigs wake and begin to move about; there is not yet enough light for them to be distinctly visible, but they appear merely as dark blots or shadows.

17. **Ata:** Shadow, slight appearance. This is explained in the same way as the preceding, but with the reference to men instead of to pigs.
18. **Mafoa ae ata:** Breaking of the shade; possibly, crack of the upper air. Dawn.
19. **Hengihengi:** Very early morning.
20. **Maa ae aho:** The day clear. Just about sunrise.
21. **Hopo ae laa:** Sunrise.
22. **Uhu,** a general term for the early morning.
23. **Pongipongi,** a general term for about sunrise to midday, like the English morning.
24. **Fangai–lupe:** Feeding pigeon. Time for those in charge of the tame pigeons to feed the birds. For Samoa this is about 9 a. m.[12]; for Tonga Baker[13] gives it as about 9 till 11 a. m.
25. **Pale ki hahake:** Slanting to east. The morning hours before the sun has come to the meridian.
26. **Tuutonu malie ae laa:** The sun standing straight, that is, midday. Another expression for this is Hoata or Hoata malie.
27. **Pale ki hihifo:** Slanting to west. The sun has now passed the meridian. Afternoon.
28. **Efiafi:** Afternoon. A general word, usually applied to late afternoon and frequently to the earlier hours of darkness, like the English evening.
29. **Hopo ae moa:** The fowl jumping, that is, the fowl going to roost. Although clocks have become fairly common, yet the Tongans frequently express the time of day by the position of the sun. An expression for "now," "this present time," is *feituu laa ni,* this place of the sun. Frequently in answer to a question as to when a thing did or will occur, the Tongan points to the sky and says, the sun was, or will be, there.

Other Tongan expressions are:

Apongipongi, tomorrow; Anoiha, the day after tomorrow; Moitolu, three days hence; Aneafi, yesterday; Aneheafi, the day before yesterday; Tua-aneheafi, the day before the day before yesterday.

MISCELLANEOUS TERMS

1. **Tapukitea,** Venus when she appears in the evening (compare Samoan *Tapuitea,* the evening star).

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[12] Pratt, op. cit. See the word *fagailupe;* Brown, op. cit., p. 348.

[13] Baker, S. W., An English and Tongan and Tongan and English Vocabulary, Auckland, 1897. See the word *fagailube.*

2. **Fetuu-aho:** Day star, or morning star. This is frequently applied to Venus in her early morning appearances, but the name seems equally applicable to any bright star whose rising closely precedes the dawn (compare Samoan *Fetuao,* the morning star).
3. **Fetuu fuka:** Flag or flagged star, a comet.
4. **Fetuu ejiafi:** Fire-bringing star, shooting star.
5. **Uha:** Rain. Belongs to great deities, the Tangaloa, who reside in the sky. This is the reason why prayers for rain were made to the goddess Tafakula, a descendant of the Tangaloa, who passed human supplications on to headquarters.
6. **Umata:** Rainbow. The rainbow belongs to a deity. It is tabu to point to the rainbow, and should one disregard this prohibition the limb with which he points will swell with elephantiasis or perhaps as with elephantiasis.
7. **Mofuike:** Earthquake—is caused by Maui digging too energetically in his garden in the Underworld. Another account, which is much more doubtful, relates that Maui, getting drowsy, lets the earth totter. Whatever the cause the remedy is simple: make a great noise and beat on the ground to recall the god to a sense of his misdemeanor.
8. **Ahiohio:** Whirlwind. A blind god, who rushes about not knowing whither he is going nor what damage he is doing. A small whirlwind is a small god and a large whirlwind a great deity. In dealing with this blind god the right procedure is to induce him to go elsewhere by making a noise so that he may know that he is interfering with men.

I desire to express my thanks to Mr. E. W. Gifford of the Bayard Dominick Expedition, Bishop Museum, who has made available information collected in 1920-1921, including interesting notes written by Miss Beatrice Shirley Baker of Haapai; to my wife, whose interest in Tongan lore places me under constant obligation; to Prince Tungi, the Consort of Her Majesty the Queen of Tonga; and to my friends and colleagues of the Methodist Mission, Rev. J. Havea, Rev. D. Malupo, and Rev. A. Tamale.

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Report of the Director for 1921

ORGANIZATION OF THE STAFF

During the year 1921 six members were added to the Museum staff; two were granted leave of absence; two resumed their duties after the termination of their leave, and two left the employ of the Museum.

Thomas G. Thrum, who had previously served the Museum as Editor of the Fornander manuscripts, entered upon his duties as Associate in Hawaiian Folklore on January 3, 1921.

C. Montague Cooke, Jr., was in residence at the Museum during July, August, and September. The remainder of the year was devoted to consultation and study of material at mainland institutions, particularly at the Philadelphia Academy of Sciences.

On account of his health, J. W. Thompson, Preparator, was granted a leave of absence from March 1 to the end of the year.

On April 1, 1921, Stanley C. Ball (Ph. B., Sheffield Scientific School and Ph. D., Yale University) was appointed Curator of Collections. After graduation from Sheffield Scientific School, Mr. Ball served as draftsman at the Tortugas Biological Station of the Carnegie Institution and later became Assistant Curator of Zoology, Peabody Museum, New Haven. From 1916 to 1918 he was Instructor in Zoology at Massachusetts Agricultural College and from 1918 to 1921, Professor of Biology at the International Y. M. C. A. College. His publications relate to general biology.

On April 22 Norman E. A. Hinds was appointed Research Associate in Geology for the year 1921. Assisted by a Harvard fellowship Mr. Hinds is engaged in the preparation of a report on the geology of the island of Kauai.

Following five months' leave of absence granted for study at the University of California, Kenneth P. Emory resumed his duties as Assistant Ethnologist on June 1.

On June 1 Edward S. Handy was appointed Ethnologist on the Museum staff. During the preceding year Mr. Handy held the position of Research Associate in Ethnology as a member of the Bayard Dominick Expedition. (See p. 205.)

On account of ill health Helen M. Helvie severed her connection with the Museum on August 1. She has given ten years of faithful and efficient service as the Superintendent of the Exhibition Halls and Guide to Exhibits.

On September 5 Edwin H. Bryan, Jr., rejoined the Museum staff as Assistant Entomologist, a position which he had held for the first half of 1920.

On September 1 Bertha Metzger was appointed Assistant to the Director. While attending the University of California, Miss Metzger was Secretary to the Dean of the College of Mechanics, and department librarian. Most of Miss Metzger's experience has been in the national parks. She was Secretary to the Manager, Yosemite National Park Company, and later became manager of the housekeeping camp and the reservation departments. She was sent from Yosemite to inventory the properties of Sequoia and General Grant National Parks. In 1921 she was Purchasing Agent in Sequoia.

Olga Smith, Secretary to the Director, left the employ of the Museum on September 24.

On December 1 James F. Illingworth (B. S., Pomona College; A. M., Stanford University; Ph. D., Cornell University) was appointed Research Associate in Entomology. Mr. Illingworth has served as head of the department of biology at the Broadway High School, Seattle (1901-1910), and as Professor of Entomology in the College of Hawaii (1912-1917). For the past five years he has held the position of Entomological Investigator for the Government of Queensland. His special interest lies in the field of economic entomology.

During the year it has been found desirable to add to the staff four temporary appointees. Miss Sarah Driver and Miss Mabel Clark served efficiently as catalogers in the library. Spencer Bickerton has acted as preparator during the absence of Mr. Thompson, and Miss Dorothy Hair assisted in the preparation of a catalog of insects.

WORK OF THE STAFF

The time of the Director, Herbert E. Gregory, has been devoted principally to enlarging the local usefulness of the Museum, carrying out plans for Pacific exploration, and establishing cooperative relations with other institutions. Attention has been given to the preparation for the press of the Proceedings of the First Pan-Pacific Scientific Conference, and to the formulation of editorial rules for the Museum publications. Field trips were made to the islands of Maui, Hawaii, and Lanai, and preliminary geological studies were made of Haleakala, the summit of Mauna Kea, and the Waianae Mountains. In June the Director gave the Commencement Address at the University of Hawaii on "Research and the community" and at the Kamehameha Schools on "The outlook for Hawaiians." An address on "The significance of scientific research in the Pacific" was delivered before the Press Congress of the World on October 18. The Director has continued his service as Chairman of the Committee on Pacific Investigation of the National Research Council and served on the Committee on Program of the Pan-Pacific Educational Conference. To meet obligations to Yale University, the month of January was spent in New Haven and December was devoted to conferences with Federal Commissions, scientific societies and educational institutions on the mainland. During the absence of the Director the administration of the Museum was in charge of Charles H. Edmondson for the period, January 1 to February 15, and of Stanley C. Ball for the month of December.

Since joining the Museum staff in April, Stanley C. Ball, Curator of Collections, has devoted his time chiefly to preparing a much-needed catalog and to classifying the materials for exhibition, student use, and exchange. (See pp. 192 and 196.) While on the mainland Mr. Ball visited several institutions in order to study museum management.

William T. Brigham, Director Emeritus, reports the completion of a manuscript on Hawaiian worship, a work which has been in progress for the past decade.

Elmer D. Merrill, Consulting Botanist, has taken the time from his exacting duties as Director of the Philippine Bureau of Science to prepare for the Museum a statement of the purpose and method of botanical work in Polynesia.

Otto H. Swezey, Consulting Entomologist, has devoted the time at his disposal to the rapidly growing collection of insects.

He has also directed the work of Edwin H. Bryan, Jr., Assistant Entomologist, and of Dorothy Hair who has nearly completed the preparation of a synonymic bibliographic card catalog of Hawaiian insects.

Clark Wissler, Consulting Ethnologist, has given much time and thought to the Museum. Experience gained as Curator of the Department of Anthropology in the American Museum of Natural History has enabled him to give to the Bishop Museum valuable advice regarding the present activities and future development in research and in exhibition.

Robert T. Aitken, Research Associate in Ethnology, has been absent during the year in the Austral Islands as a member of the Bayard Dominick Expedition. He arrived in Papeete on October 30 but was unable to procure transportation to his field of work until January, 1921. On account of severe illness contracted in Tubuai Mr. Aitken returned to Papeete early in May, sailing again for Tubuai on September 13. For the remainder of the year investigations were continued in Rurutu, Raivavae and Tubuai. The Museum has received from Mr. Aitken some valuable specimens and manuscripts.

Forest B. H. Brown, Botanist, has devoted the year to a study of the flora of the Marquesas with special reference to its bearing on the migration of the Polynesian race. He is accompanied by his wife, Elizabeth Wuist Brown, Research Associate in Botany. See p. 208.)

Since his return to the staff, Edwin H. Bryan, Jr., Assistant Entomologist, has mounted and labelled some 6,000 specimens of Australian insects collected by J. F. Illingworth, and has arranged for study about 16,000 Hawaiian insects, the accumulation of six or eight years of collecting by members of the Museum staff. Mr. Bryan has also undertaken the considerable task of cataloging approximately 2000 photographic negatives and of developing a check system for instruments.

C. Montague Cooke, Jr., Malacologist, devoted a large part of the year to a study of the shells and the anatomy of Zonitidae and Succineidae. This work was done at the Philadelphia Academy of Natural Sciences where a rich collection of material is available for comparison. The time spent in Hawaii was given to cataloging, naming collections, and to field work which has yielded interesting results. (See p. 209.) Mr. Cooke's study of six species of Succineidae and of three of the rarest genera of Zonitidae found in the islands was published by the Museum as Occasional Papers Volume VII, Number 12.

Henry E. Crampton, Research Associate in Zoology, has continued his work on the variation, evolution and distribution of the genus Partula. Two months were spent on Guam and a short visit was made to Saipan. A study of the material from this part of the Pacific gives some interesting results. (See p. 210.)

Arthur J. Eames, Research Associate in Botany, was prevented by serious illness from carrying out his plan for the study of the flora of Tonga as a member of the Bayard Dominick Expedition. An attack of dysentery at Apia forced his return to the United States. In the short time available for work Mr. Eames collected about 1,200 sheets of Samoan plants and made some useful observations on the reliability of plant names as a guide to race migrations.

Charles H. Edmondson, Zoologist, has devoted much time during the year to arranging and classifying the zoological material in the Museum and to enriching the collections by exchange and by field studies. (See p. 200 and p. 211.) In addition to his exacting duties at the University of Hawaii and at the Marine Biological Laboratory, Mr. Edmondson has found time to deliver twelve public lectures on the marine fauna of Hawaii and to prepare two papers: "Stomatopoda in the Bishop Museum" and "Hawaiian Dromiidae" which have been issued as Occasional Papers Vol. VII, No. 13, and Vol. VIII, No. 2.

Since returning from graduate study at the University of California, Kenneth P. Emory, Assistant Ethnologist, has made an archaeological and ethnological survey of the island of Lanai. The results include a map of the island, a list of place names, a relationship tree including every native on Lanai, and a record of all petroglyphs and ruins. Of the value of this work Dr. Clark Wissler remarks, "There is every reason to believe that the story of the Polynesian on Lanai will be a cross-section of his career elsewhere."

Edward W. Gifford, Research Associate in Ethnology, returned from Tonga in June after a nine months' study of the religion and social organization. He reports the collection of an unexpectedly large amount of data bearing on the history of the Polynesians. The results of his work are in preparation for publication. (See p. 207.)

Ruth H. Greiner, Bishop Museum Fellow, has made considerable progress in her study of Polynesian designs on carved and decorated objects. The Marquesan and Hawaiian designs have been analyzed into "design elements," and materials from other parts of Polynesia are being studied, with a view to throwing light on migrations.

Edward S. Handy, Ethnologist, returned in October from the Marquesas, where he spent nine months as a member of the Bayard Dominick Expedition. The time since his return has been devoted to the preparation for publication of his material on religion, social organization, and linguistics. Mrs. Handy, volunteer associate with the Marquesan party, made a special study of the tattooing and household arts of the Marquesans. (See p. 205.)

J. F. Illingworth, Research Associate in Entomology, has devoted his attention to the arrangement and study of the large collection of insects obtained by him in Australia. (See p. 202.)

Ralph Linton, Research Associate in Archaeology, returned in August from a year of intensive study of the archaeology and material culture of the Marquesas. In addition to notes, maps, and photographs, Mr. Linton brought back many valuable specimens of ethnologic interest. By the end of the year a large part of his results was in manuscript awaiting revision and publication in the series of reports of the Bayard Dominick Expedition.

After a year's field investigation as a member of the Bayard Dominick Expedition, W. C. McKern, Research Associate in Ethnology, returned to Honolulu in June. The months of July, August, and September were spent at the Museum in a comparative study of collections and of library material. The remainder of the year was devoted to the preparation of a manuscript on the primitive material culture and archaeology of the Tongans.

G. C. Munro, Associate in Ornithology, has continued to make records of native and migratory birds. In an effort to find the unique bird (*Dysmorodrepanis munroii*) many trips were made in the forest region of Lanai and a trail was cleared in the Kaiholena valley where this bird was last seen.

During the absence of Mr. Cooke, Marie C. Neal, Assistant Malacologist, has been in charge of the collection of land shells. Her laboratory work has consisted of cataloging, preparing material for study, and arranging specimens for exchange. Field work included collecting trips to Kauai and to windward Oahu. In connection with her investigations Miss Neal carried on graduate work at the University of Hawaii.

F. L. Stevens, Bishop Museum Fellow, spent five months on the islands of Hawaii, Kauai, Oahu, and Maui, in a field and laboratory study of Hawaiian fungi. At the close of the year his large collection had been classified and part of his manuscript report completed.

John F. G. Stokes, Ethnologist, has spent the year in field studies as a member of the Bayard Dominick Expedition. He arrived in Tahiti October 30, 1920, but inability to procure transportation delayed his arrival at Rurutu until December 25. After three months' stay in this island Mr. Stokes went to Rapa by way of Rimatara. Since April 15, 1921, no communication has been received from him.

The program for the study of physical anthropology begun in 1920 by Louis R. Sullivan was continued during the present year. Altogether nearly 11,000 persons have been examined to furnish data on physical characteristics, race mixture and racial differences in growth. To supplement the material obtained in Hawaii, the collections in Peabody Museum (Cambridge) were studied. Mr. Sullivan completed two papers, "A contribution to Samoan somatology" and "A contribution to Tongan somatology." (See pp. 185 and 186.) Mr. Sullivan was the delegate from the Bishop Museum to the Second International Eugenics Congress held in New York, and was in charge of the exhibit of Hawaiian casts, photographs, and diagrams which were prepared under his personal direction. (See p. 191.)

During the year Thomas G. Thrum studied the Poepoe collection, consisting of 42 manuscripts, and submitted a report on their condition and merit with reference to publication. Much time was also given to the assembling of data regarding the use of astronomy by early Hawaiian voyagers. Several Polynesian vocabularies submitted for publication were also studied. A large part of Mr. Thrum's time was spent on the preparation of a list of geographic terms for the revision of Andrews' Hawaiian Dictionary. (See p. 190.)

In his study of tropical hurricanes Stephen S. Visher, Bishop Museum Fellow, has collected published and unpublished data at Honolulu, Suva, Melbourne, Manila, Hongkong, Shanghai, Kobe, and Tokio. In addition to popular articles he plans to prepare for publication by the Museum a monograph on tropical cyclonic storms of the Pacific.

Gerrit P. Wilder has continued his valued activities in enriching the Museum collection of fruits and plants and has used his expert knowledge in providing correct labels for the casts of fruits in the exhibition halls.

Elizabeth H. Higgins, Librarian and Editor, has supervised the reclassification and cataloging of the library and has shared the burden of preparation of manuscript for the press. The distribution of publications has demanded an unusual amount of attention. (See pp. 187 and 212.)

Before entering upon his leave of absence, John W. Thompson, Preparator, enriched the Museum collections by the addition of casts and models. (See p. 202.)

In addition to her routine duties as Assistant to the Director, Bertha Metzger has assisted in preparing for publication the Proceedings of the First Pan-Pacific Scientific Conference and the revised Hawaiian Dictionary, and has assumed charge of proofreading.

Since the retirement of Helen M. Helvie on August 7, Lahilahi Webb has held the position of Guide to Exhibits. Ably assisted by Anna Ho, she has served as hostess to an increasing number of visitors. The influential position in the community held by Mrs. Webb has greatly assisted in bringing the Museum and the Hawaiians into sympathetic relations. Her intimate knowledge of the Hawaiian language and history has been continuously utilized by members of the staff and by visitors to the exhibition halls.

Valuable assistance has come to the Museum from men not officially on the staff.

Rev. E. E. V. Collocott, President of the Tubou College, Nukualofa, Tonga, has prepared two papers, "Proverbial sayings of the Tongans" and "Tongan astronomy and calendar," for publication by the Museum. (See p. 187.)

Commander J. C. Thompson, U. S. N., in charge of the naval hospital at Guam, a well known student of natural history, has offered his services as collector and as recorder of anthropological data in Guam.

Mr. D. Wesley Garber, Chief Pharmacist's Mate, U. S. N., has taken advantage of his stay in Samoa to obtain anthropometic records and to make collections for the herbarium.

The Museum is under obligations to Mr. H. D. Skinner, Lecturer in Anthropology at the University of Otago. Mr. Skinner found it impracticable to serve as a member of the Bayard Dominick Expedition but at the request of the Museum he undertook a field and laboratory study which has resulted in a valuable manuscript on "The Moriori of Chatham Islands."

PUBLICATIONS

During 1921 the following publications were issued:

MEMOIRS VOLUME VIII, NUMBER 1. A monographic study of the genus Pritchardia, by Edoardo Beccari and Joseph F. Rock, 77 pages, 24 plates, 1 figure, 1921.

Systematic discussion of the palm, Pritchardia, a characteristic feature of the Polynesia flora; 74 per cent of the genus is endemic in Hawaii.

MEMOIRS VOLUME VIII, NUMBER 2. A contribution to Samoan somatology, by Louis R. Sullivan. Bayard Dominick Expedition Publication Number 1. 20 pages, 2 plates, 1 figure, 1921.

A discussion of the physical characters and racial affinities of the Samoans, based on the examination of 93 native adults by E. W. Gifford and W. C. McKern.

OCCASIONAL PAPERS VOLUME VII, NUMBER 10. Fish poisoning in the Hawaiian islands, with notes on the custom in Polynesia, by John F. G. Stokes, 17 pages, 3 plates, 1921.

A description of preparation and application of poison obtained from the plants *auhuhu* and *akia*.

OCCASIONAL PAPERS VOLUME VII, NUMBER 11. An archaeological survey of Haleakala, by Kenneth P. Emory, 25 pages, 4 plates, 3 figures, folded map, 1921.

The location and description of many stone structures hitherto undescribed. Includes revised list of place names.

OCCASIONAL PAPERS VOLUME VII, NUMBER 12. Notes on Hawaiian Zonitidae and Succineidae, by C. Montague Cooke, Jr., 17 pages, 2 plates, 5 figures, 1921.

A revision of two families of Hawaiian land shells based on anatomical studies. Two new genera and five new species are described.

OCCASIONAL PAPERS VOLUME VII, NUMBER 13. Stomatopoda in the Bernice P. Bishop Museum, by Charles Howard Edmondson, 24 pages, 2 figures, 1921.

The relationship and distribution of six genera and nine species of Squillidae are discussed. One new species is described.

OCCASIONAL PAPERS VOLUME VIII, NUMBER 1. Report of the Director for 1920, by Herbert E. Gregory, 28 pages, 1921.

SPECIAL PUBLICATION NUMBER 7. Proceedings of the First Pan-Pacific Scientific Conference (in three parts), 949 pages, 21 figures, 1921.

The proceedings read at the Scientific Conference held at Honolulu, Hawaii, August 2 to 20, 1920. Part I includes an historical introduction, the organization and minutes of the general session and the sections, list of delegates, papers on race relations in the Pacific, on Hawaiian fauna and flora, botany, and fisheries, and also chapters on biological stations with plans for biological work in the Pacific. Part II contains chapters on volcanology, seismology, meteorology, oceanography, ocean currents in relation to organisms, and mapping the Pacific. Part III is devoted to discussions of the status of areal geological surveys and correlations of Post-Cretaceous formation of the Pacific region and to symposia on means and methods of co-operation and training of scientists for Pacific work.

Pages 1-49 of Part I, containing organization, summarized proceedings, resolution and personnel, are published as a separate pamphlet.

The following publications are in press. They will appear early in 1922:

MEMOIRS VOLUME VIII, NUMBER 3. Grasses of Hawaii, by A. S. Hitchcock, 131 pages, 5 plates, 110 figures.

Describes 50 genera of native and introduced grasses.

MEMOIRS VOLUME VIII, NUMBER 4. A contribution to Tongan somatology, by Louis R. Sullivan, 30 pages, 4 plates, 1 figure.

Describes the physical characteristics of 225 Tongans, and discusses the relation of Tongans to Samoans and to Melanesians.

OCCASIONAL PAPERS VOLUME VII, NUMBER 14. Dermaptera and Orthoptera of Hawaii, by Morgan Hebard, 76 pages, 2 plates, 1 figure.

A study based on 688 specimens representing 40 of the 41 genera and all but two of the adventive species recorded for Hawaii.

OCCASIONAL PAPERS VOLUME VIII, NUMBER 2. Hawaiian Dromiidae, by Charles Howard Edmondson, 10 pages, 2 plates.

Discussion of the taxonomic position, characteristics and distribution of the Dromiidae of Hawaiian waters. One new subspecies is described.

OCCASIONAL PAPERS VOLUME VIII, NUMBER 3. The proverbial sayings of the Tongans, by E. E. V. Collocott and John Havea.

An epitome of Tongan mental reactions as expressed in 633 proverbs given in the Tongan dialect with translation and comment in English.

The following papers are in the hands of the Editor:

Secondary xylem of Hawaiian woods, by Forest B. H. Brown.
Material culture of the Morioris of the Chatham Islands, by H. D. Skinner.
Tongan astronomy and calendar, by E. E. V. Collocott.
Hawaiian dictionary.

Papers in preparation include the following:

Tongan ethnogeography, by E. W. Gifford.
Tongan society and religion, by E. W. Gifford.
Tongan material culture and archaeology, by W. C. McKern.
Marquesan material culture, by Ralph Linton.
An outline of Marquesan ethnology, by Edward S. Handy.
Studies in Hawaiian anthropology, by Louis R. Sullivan.
Archaeology and ethnology of Lanai, by Kenneth P. Emory.
Polynesian design, by Ruth H. Greiner.
Hawaiian fungi, by F. L. Stevens.
A Rarotongan dictionary, by S. Percy Smith.
Palmyra crustacea, by Charles Howard Edmondson.

In the titles of Museum publications two changes are made: (1) The books and pamphlets heretofore listed as Miscellaneous Publications have become Special Publications; (2) the series of Occasional Papers will, after the completion of Volume VIII, be continued as Bulletins. No change is contemplated in the Memoirs.

The liberal policy adopted by the Trustees has resulted in an unprecedented call for the publications of the Museum. During the year 3,236 numbers of Memoirs were distributed including 96 complete sets; 6,561 numbers of Occasional Papers, including 83 complete sets; 748 numbers of Fauna Hawaiiensis including 41 complete sets, and 607 copies of other special publications. The regular distribution of publications at time of issue has been about 300. To the regular exchange list which now numbers 161, the names of the following institutions have been added: Arnold Arboretum, Jamaica Plain, Massachusetts; British Museum of

Natural History, London, England; College of Science, Imperial University, Tokyo, Japan; Danish Biological Station, Copenhagen, Denmark; Danish Natural History Association, Copenhagen, Denmark; Gesellschaft fur Erdkunde zu Berlin, Berlin, Germany; Historical Society of Victoria, Melbourne, Victoria, Agricultural Research Institute, Pusa, Bihar, India; Instituto do Butantan, Sao Paulo, Brazil; Journal Officiel des Establissements Oceaniennes, Papeete, Tahiti; Kyoto Imperial University, Kyoto, Japan; Lyon Museum des Sciences Naturelles, Lyons, France; Marine Biological Laboratory, Woods Hole, Massachusetts; Musée Coloniale de Marseille, Marseilles, France; Musée Royale d'Histoire Naturelle, Brussels, Belgium; Museo Civico di Storia Naturali di Genova, Genoa, Italy; Museo Nacional, Mexico City, Mexico; Museum National d'Histoire Naturelle, Paris; Puget Sound Biological Station, Seattle, Washington; Real Sociedad Geografica, Madrid, Spain; Royal Colonial Institute, London, England; Royal Geographical Society of Queensland, Brisbane, Queensland; Royal Horticultural Society, London; Royal Scottish Geographical Society, Edinburgh, Scotland; Societa Italiana di Scienze Naturali, Milan, Italy; Société de Géographie Commérciale du Havre, Le Havre, France; Société National d'Acclimation de France, Paris; University of Nebraska, Lincoln, Nebraska; and University of Washington, Seattle, Washington.

Classified by subjects the publications received from these institutions—serials that will continue to be received currently—are: ethnology, 2; natural history, 13; general science, 4; geography, 7; botany, 3.

SPECIAL TOPICS

Bishop Museum Fellowships

Of the four Bishop Museum Fellowships founded by Yale University in cooperation with the Museum three were filled for the year 1921. F. L. Stevens, Professor of Plant Pathology, University of Illinois, conducted researches on Hawaiian fungi to supplement his previous work done in the American tropics. Ruth H. Greiner, graduate student at the University of California, has devoted her attention to design elements in Polynesian carving, painting, and decoration. Stephen S. Visher, Professor of Geography, University of Indiana, has visited Suva, Melbourne, Manila, Hongkong, Shanghai, Kobe, Tokyo, and Honolulu in search of data bearing on the problem of tropical hurricanes as a factor in the distribution of life in the Pacific.

As indicated by the reports of progress and by incomplete manuscript submitted the holders of these fellowships have been enabled to make clearly defined contributions to the knowledge of the Pacific. This pioneer method of adding eminent specialists to the group of Pacific workers has received general approval as part of a constructive program. The National Research Council has called the attention of eight universities to the desirability of establishing similar fellowships, and at the request of the Council the Director has visited five of these institutions for personal conference.

PAN-PACIFIC SCIENTIFIC CONFERENCE

The relations of the Museum to the First Pan-Pacific Scientific Conference described in the Report of the Director for 1920, pp. 15-16, continue. The request of the Conference that the Museum "publish and distribute the reports, papers and proceedings" has been fulfilled by the publication of the Proceedings of the Conference. (See p. 186.) Accumulating evidence shows that the work of the Conference is a constructive contribution to scientific research in the Pacific, and that the published Proceedings will find large use. Acting as "representative of the members of the Conference after its adjournment" the Bishop Museum has furnished information by correspondence and through scientific journals in regard to activities and plans within the scope of the Conference, has kept closely in touch with the Committee on Future Conferences, and is actively cooperating with the National Research Council and with scientific bodies of other Pacific countries in plans and projects designed to bring to fruition some of the resolutions passed at the Conference.

MANUSCRIPTS AND LITERARY NOTES OF WILLIAM CHURCHILL

The late William Churchill, whose researches in Polynesian geography, linguistics, and folklore indicate a scholar of unusual attainments, bequeathed to the Carnegie Institution of Washington his manuscripts, notes, and papers. This material has been lent to the Museum with a view to the completion of the investigation on which Mr. Churchill was engaged at the time of his death which occurred August 10, 1920. The inventory embraces 38 items. Among the manuscript are translations of legends and genealogies in Samoan and other dialects, manuscripts on the Pacific colonies of Germany, Samoan relations, Tanumafile succession and miscellaneous historical, philological, and political papers. Perhaps the most valuable of Mr. Churchill's bequests is some 30 boxes of cards representing the progress made toward the preparation of a Samoan-English dictionary.

HAWAIIAN DICTIONARY

Interest in Polynesian linguistic studies and the need of an authoritative reference book for the spelling, pronunciation, and definition of Hawaiian words led to arrangements for revising Andrews' Hawaiian Dictionary, issued in 1865 and long out of print. Supported by a legislative grant of $25,000 revision has been in progress since January, 1915, under the direction of the Board of Commissioners of Public Archives, who placed Rev. Henry H. Parker in charge of the work.

At the request of the Board in May, the Museum assumed the responsibility of completing the revision and of publishing the work. In addition to the task of preparing for the press the manuscript and notes transmitted by the Board the Museum has agreed to furnish a list of Hawaiian geographical names with pronunciation and definition. To make this list authoritative all accessible sources were examined including the Mahele or Book of Awards and the original records of the Land Office and of the Survey Department. Mr. Thrum, on whom the burden of this work has fallen, acknowledges the helpful cooperation of Mr. Joseph S. Emerson, Mr. Stephen Mahaulu, Mrs. Lahilahi Webb, Mr. L. A. Dickey, Mr. Thomas C. White and Mr. Theodore Kelsey.

THE GARTLEY COLLECTION OF PHOTOGRAPHS

The gift by Mrs. Alonzo Gartley of the photographic negatives taken by her husband is worthy of special mention. The collection consists of 649 large negatives and panoramic views of Hawaiian landscapes, plants, and native peoples, all of which demonstrate exceptional skill in composition and execution. For the subjects treated the Gartley collection is doubtless the most valuable in existence. It constitutes a suitable memorial of an enthusiastic student of Hawaiian natural history.

PHOTOGRAPHS IN THE MUSEUM

The enlargement of the Museum activities and its cooperative contacts recently established with similar institutions have increased the call for photographic prints for use as illustrations and for comparative studies. To meet this need the preparation of a catalog of photographs, begun in 1920, has been continued. A record, including description, title, date, and the name of the photographer, has been supplied for photographs taken since 1919 and so far as practicable for those taken previous to that date. Of the partly cataloged collection of 2,780 negatives made by members of the staff before 1920, about 2,200, chiefly of specimens in the Museum and subjects of personal interest, have been credited to Dr. Brigham; 510, ethnological subjects, to Mr. Stokes; and 72, botanical subjects, to Mr. Forbes, 1,109 negatives were added in 1920 and 2,013 in 1921.

In addition to large numbers of photographs of historical subjects the Museum files include about 5,900 negatives of value for scientific study and about 600 prints of which the negatives are not the property of the Museum. In regular course the negatives made by members of the staff will increase in number and value but it seems desirable to provide for students interested in the Pacific studies by building up the collection of prints from outside the Museum.

EXHIBITION AT THE EUGENICS CONGRESS

With the cooperation of the University of Hawaii, Punahou Schools, and Kamehameha Schools, the Museum prepared a rather elaborate exhibit of the racial types in Hawaii to be sent to the Second International Congress of Eugenics held in New York City, October, 1921. The exhibit consisted of a full figure of David Kahanamoku, 54 busts cast from life by Gordon C. Usborne, 7 large charts dealing with population, intermarriage, and vital statistics, and a large number of photographs. Chinese, Japanese, Koreans, Filipinos, Portuguese, Americans, Hawaiians, and the numerous Hawaiian mixtures are represented in the casts and photographs.

The exhibit arrived in New York in October, 1921, and was placed in the American Museum of Natural History in the Hall of the Age of Man where the sessions of the Congress were held and is still retained as a special exhibit. The American Museum has been given permission to duplicate the exhibit, after which it will be returned to the Bishop Museum.

In supplying subjects for the casts and photographs cordial cooperation has been received from leaders among the different racial groups. Special mention should be made of Dr. Iga Mori, Rev. S. Y. Whang, and Miss Whang, Rev. B. P. Makapagal, Mr. Lee Toma, President Dean of the University of Hawaii, President Griffiths of Punahou, Principal Wood of the Normal School, Principal Givens of McKinley High School, Mrs. Max Carson, and Mr. F. D. Lowrey. The Kamehameha Schools as represented by President Webster, Principal Bartlett, and Principal Newton have been responsible in large measure for the successful completion of this project.

PACIFIC BIRD LIFE

The Whitney South Seas Expedition of the American Museum of Natural History is engaged in a comprehensive study of the bird life of the islands of the Pacific. Through the generosity of the American Museum duplicate series of birds, of other zoological materials, and of plants obtained by the Expedition will serve to enlarge the collections of the Bishop Museum.

Fortunately the Bishop Museum is able to cooperate by supplying the American Museum with representative material from the Hawaiian Islands and to a small extent from other parts of the Pacific.

THE MUSEUM COLLECTIONS

The funds of the Museum are expended on two closely related activities: (1) the gathering and care of scientific materials, and (2) investigation. The collections are not only permanent records of vanishing things and objects of educational significance but they constitute source materials from which investigation derives much of its value. They demand special attention, for the worth of collected material is decreased or even destroyed by the absence of complete and easily accessible records of the original history.

The method adopted by most museums for preserving, preparing for use, and exhibiting materials is to organize the staff as a group of curators, each one charged with responsibility for the particular class of objects about which his knowledge or interest centers. For institutions whose interest is solely in the storage and public exhibition of materials and for museums whose activities call for departmental staffs, this system has obvious advantages but it seems to be not so well adapted to institutions with small staffs engaged in a variety of tasks. For the Bishop Museum at least this organization has not proved satisfactory; the divided responsibility resulted in careful attention to some classes of materials and neglect of others and a lack of systematic plans for building up the collections with reference to the needs of students in Hawaii and elsewhere.

As indicated in the Report of the Director for 1920 it has been found desirable to merge the various curatorships into one Curator of Collections who has charge of all collections belonging to the Museum except the books and photographs. The position is difficult to fill, for it calls for an experienced scientist whose attainments include familiarity with the needs and practice of educational institutions and artistic skill regarding the adequate display of exhibition material. The Museum is fortunate in filling the newly made position by the appointment of Stanley C. Ball. As a preliminary study the Curator of Collections has examined all collections belonging to the Museum with a view to providing a permanent record and a classification into the groups: material for exhibition, material for study, and material for exchange. The admirable Preliminary Catalogue prepared by William T. Brigham and published in 1892-93, in which are listed all the ethnological and natural history specimens of the Museum at that period of its history, and also photographs, portraits, relics, and items of historical interest, is being used as a basis for this work. Additional sources are the lists of accessions publihed in the annual report of the Director since 1899 and the accession records kept by members of the staff. Fortunately for some classes of material a full and accurate catalog has been kept and for other collections it has been possible to obtain sufficiently complete information to supply the data required for labeling.

THE MUSEUM AND THE PUBLIC

Beginning with the year 1919, an effort has been made to bring the Museum into closer contact with the people of Hawaii, using its resources to enlarge the educational facilities of the Territory and to increase public interest in the study and preservation of the record of the Polynesian race. The response of the public to this desire to render a larger service has been gratifying. The number of visitors to the exhibition halls is increasing; the use of study collections and consultation with members of the staff by amateur and professional scientists is becoming more frequent; and the Museum's publications are finding more readers.

Analysis of the records of attendance in the exhibition halls as presented in the Annual Reports of the Director present some interesting information. From 1899 to October, 1911, the halls were regularly open to the public two days a week. For the first year of record (1899), the number of visitors was 8,399 and the average for the first five years (1899-1903) was 7,538. For the next eight years (1904-1911) the average attendance was 11,659 with a maximum of 14,296 in 1905—a significant increase attributed to the attractive exhibits in the newly constructed Hawaiian Hall. Beginning with October, 1911, and extending to September, 1919, the Museum was open five days a week during which period the records show an average yearly attendance of 14,619 with a maximum of 15,657 in 1917. For the past four years the attendance has been: 1918, 14,029; 1919, 19,074; 1920, 29,159; 1921, 30,313. This marked increase is partly due to the decision to open the Museum seven days a week and to enlarged tourist travel but seems to be principally the result of increased interest on the part of the public.

As might be expected the white population makes most use of the exhibition halls, constituting roughly 48 per cent of the attendance since the founding of the Museum. During the past ten years it has exceeded 50 per cent except for the war years, 1918 and 1919. The number of Japanese visitors first became conspicuous in 1904, and since that date has averaged about 19 per cent of the total attendance with a high record of 34 per cent in 1909. For the Chinese the largest attendance is recorded for 1904 and 1905, during which years representatives of this race made up nearly 18 per cent of the total attendance. Since 1905 the percentage of Chinese has gradually decreased to about 7 per cent in 1921. The percentage of Hawaiians likewise decreased from about 17 per cent in 1904 to 10 per cent in 1917 but rose again to 15 per cent during the past two years. Classified by races the attendance for 1921 was: white, 16,993; Hawaiians, 4,847; Chinese, 2,148; Japanese, 5,696; others, 629; total, 30,313. It is interesting to note that the number of Japanese visitors for the year is 889 less than for 1920 and only 1,696 more than for 1909 (4,000), the largest recorded previous to 1920. The Chinese attendance reached a maximum (2,527) in 1905, and has been less than 2,000 except for the periods 1904-1906 and 1919-1921. The attendance of Hawaiians shows a gratifying increase. For the period 1899-1918 the average number was 1,462, being greatest in 1904 and 1905. For the past three years the figures are 1919, 3,090; 1920, 4,229; 1921, 4,847. As compared with 1918 (1,867) an increase of 2,980 or over 250 per cent is recorded.

The attendance in proportion to the population compares favorably with that of other museums but in one respect the record is unsatisfactory. In some mainland museums children of school age constitute as much as 50 per cent of the visitors; at the Bishop Museum the proportion is very much smaller. It is the hope of the Director that excursions to the Museum supplemented by informal lectures by teachers and by members of the Museum staff may attain an established place in the course of study of public and private schools.

In another respect the attitude of the public toward the Museum is gratifying. Whenever called upon to assist in the work of the Museum representative citizens of the territory have generously responded. In fact much of the field work done during the year was made possible by the cooperation of such men as Donald Macalister of Kukaiau ranch, A. W. Carter of Parker ranch, Samuel A. Baldwin and Harry A. Baldwin of Maui, George

C. Munro of Lanai, George P. Cooke, A. L. C. Atkinson, and C. S. Judd.

The members of the parties working outside of Hawaii report that after the scope and aims of the Museum become known, a cordial response is received from government and church officials, merchants, and leading citizens. In no small degree the successful outcome of the work of the Museum in Tonga, the Marquesas, Samoa, and Tahiti is due to the fact that information and facilities for work otherwise unobtainable have been freely provided.

Successful working arrangements with institutions on the United States mainland and in other countries and the gifts to the collections and library listed in this report testify to the growing confidence in the Museum as an institution devoted to the advancement of knowledge in the Pacific.

REPORT OF THE CURATOR OF COLLECTIONS

The Curator of Collections, Stanley C. Ball, has submitted the following report:

ACCESSIONS 1921

ANTHROPOLOGICAL MATERIAL

Additions to the collections illustrating physical anthropology include a skeleton from Mokapu Peninsula, Oahu, presented by Mr. H. Gregson, ten skulls from the Marquesas collected by Ralph Linton, and six skeletons from Tonga collected by W. C. McKern and E. W. Gifford.

The ethnological collections have been enriched by gifts as follows:

Mr. A. L. C. Atkinson, old outrigger canoe; Mr. S. A. Baldwin and Mr. A. F. Judd, 12 sling stones from Haleakala; Miss Pleiades Colburn, stone image representing head of Kamehameha I; Mr. C. H. Cooke, Jr., small image carved from fish jaw, second of its kind received, from Molokai; Mrs. Arthur Curtiss James, Hawaiian bed tapa and calabashes; Mr. A. F. Judd, wooden bowl and spoon from the Philippines, 1 Fijian club, 28 escutcheons, 7 sinkers for octopus hooks, 1 awl, stone artifacts from Molokai; Mrs. A. F. Judd, carved wood, probably Polynesian; Mr. C. S. Judd, olona bark; Mr. Philip Kaauwai, 3 ulumaika, 5 fish-hooks, olona fish line, leiomano, mat, calabash, and cane; Rev. Y. S. Mark, ornamental comb from Tonga; Rev. R. C. Page, comb from Tonga; Outrigger Canoe Club, 2 old outrigger canoes; Mrs. Anthony Richley, 1 salt pan, 2 sling stones, 2 ulumaika; Rev. A. M. Saunders, kawa cup from Tonga; Mr. Philip E. Spalding, small image of human head carved on a fish jaw, the first of its kind received, from Molokai; Mrs. E. J. Walker, portion of a hat made of split maidenhair fern stems, received through Kenneth P. Emory, November, 1920.

Ethnological material collected by members of the staff includes the following:

Bayard Dominick Expedition—Austral Islands party, 4 boxes of artifacts and wood samples. (Reserved for description in the 1922 Report); Bayard Dominick Expedition—the Marquesas party, 306 specimens from the Marquesas islands of which the following may be mentioned: 4 large wooden tribal gods, 7 carved house posts, 30 food pounders, 49 adz heads, 3 chisels, 10 tapa beaters, bed of fire-plow, paddle club from burial cave, tunable flute, 3 carved wooden bowls, stone tapa anvil, wooden drums, several ear and wrist ornaments, crowns, necklaces, 13 tapa, 2 pandanus mats. Bayard Dominick Expedition—Tonga party, 3 adzes, 1 adz haft, 9 adz heads, 3 baskets, 6 war clubs, club (Samoan or Fijian?), staff, paddle, tapa beater, nose flute, 4 sail needles, 5 fish-hooks, 2 octopus catchers, 2 tapas, 18 samples of rope and cord, pebbles and fragments of pottery, bone and shell from graves, 101 shells from mollusks used by the Tongans in the arts or as food; Kenneth P. Emory, 2 bowling stones, 97 sling stones, 3 unidentified stone artifacts collected on the island of Maui September 1920, and 3 lots of artifacts from the island of Lanai to be described in the 1922 report.

Purchases for 1921 are 2 old finger bowls, 7 poi bowls and pestle belonging to Queen Emma, and a collection consisting of 2 adz heads, sinker, stone lamp, 4 ulumaika discovered in an excavation at Kaimuki, Oahu.

By exchange 14 stone implements representative of the mound builders were received from Prof. W. H. Sherzer of the Michigan State Normal School.

Materials of ethnological and historical interest placed on deposit and classified on the Museum records as loans consist of the following collections: Mrs. Laura Buffandeau, 2 feather lei, enlarged photograph of Nancy Sumner, oil portrait of Maneiula Sumner, old English Bible (MDCCXII), lithograph of the funeral of Kamehameha III, letters and papers, 2 silk kihei, bronze seal of Republic of Hawaii, bow of Mohawk Indians, poisoned arrow, Korean pipe, carabao horns, portraits of Kamehameha I, and of Pomare of Tahiti, framed certificate; Mr. S. M. Damon, 490 specimens chiefly Hawaiian; a few from other Polynesian islands, Micronesia, Philippines, China, Alaska, South Africa, and Europe (see p. 202); Mr. A. F. Judd (Hawaiian specimens except as otherwise indicated), 3 wooden platters, 10 calabashes, 2 spears, 1 carrying stick, 1 adz head, 1 poi pounder, 1 pestle, 2 kukui nut lei, 2 cowry lei, 1 ivory lei, 1 string shell money, 1 dagger, 2 Philippine swords, 1 string of shell money from Gilbert Islands; Liliuokalani Estate, royal coach, harness and livery; 2 royal standards, songs and stories of Liliuokalani, other songs, 6 certificates of membership of J. O. Dominis, escutcheon, 3 books, trinkets, 6 photograph albums, mounted photographs, documents, relics, and miscellaneous specimens.

BIRDS

The following specimens have been added to the ornithological collections: 34 birds' eggs from Forfarshire, Scotland, presented by Mr. William M. Bush; 4 Hawaiian bird skins, presented by Mr. Albert F. Judd; fossil egg from Laysan guano bed, placed in the Museum by Mr. S. M. Damon;

a dried apapane (*Himatione sanguinea*), collected by Herbert E. Gregory on the summit of Mauna Kea; pheasant cuckoo (*Centropus phasimus*), stone plover (*Burhinus grallarius*), and kingfisher (*Dacelo leachii*), from Queensland, collected by J. F. Illingworth.

INSECTS

From the carefully kept record of Otto H. Swezey, Consulting Entomologist, the following list of accessions for 1921 has been abstracted. It will be noted that most of the new material came from foreign sources.

Collections by members of the Museum staff include 315 Hawaiian insects, 77 North American specimens collected by Edwin H. Bryan, Jr., while on the way from Connecticut to Hawaii, and 12 specimens from Tongatabu collected by Mrs. Delila S. Gifford.

Material received in exchange came from the following sources: Boston Society of Natural History, 28 North American Trypetidae; Dr. W. E. Britton, 3 specimens of *Eutreta sparsa;* Mr. B. Preston Clark, 1451 specimens, mostly Coleoptera, collected by Mr. J. August Kusche on the islands of Kauai, Oahu, and Hawaii; Mr. W. M. Davidson, 56 North American Syrphid flies.

The following donations have been gratefully acknowledged: Mr. W. M. Giffard, a collection of about 1500 mounted specimens from Samoa; Mr. W. H. Meinecke, 6 Hawaiian ant lions, 4 *Triatoma rubrofasciata;* Peabody Museum of Yale University, 801 specimens of typical North American insects; United States National Museum, 2 specimens of *Eutreta sparsa.*

A series of approximately 20,000 specimens of Australian insects has been deposited in the Museum by their collector, J. F. Illingworth. Most of them are mounted and have been labeled by Mr. Illingworth assisted by various Australian entomologists.

A collection consisting of 270 types and paratypes of the 171 species of Sierola have been given by Mr. David T. Fullaway. They include the species described by Mr. Fullaway in "New species of Sierola with explanatory notes" (B. P. Bishop Museum, Occ. Papers Vol. VII, No. 7, 1920).

The Museum has purchased from Mr. W. M. Giffard a collection of several thousand specimens representing the chief order of insects of the Oriental, Malayan, and Polynesian regions.

The seven small lots of insects collected by J. August Kusche from Solomon, Thursday, and Prince of Wales islands (see report of the Director for 1920, p. 22) have been returned to Mr. Kusche.

PLANTS

Hawaiian plants received during the year are: ferns from Oahu donated by Mr. A. F. Judd; Abutilon from Oahu collected by Otto H. Swezey; ferns from the island of Hawaii collected by Mr. Gerrit P. Wilder; and a portion of a petrified tree from Kauai donated by Mrs. V. Knudsen. From members of the Bayard Dominick Expedition collections of unidentified plants from New Zealand, Tonga, and Samoa have been received. Professor C. J. F. Skottsberg of Upsala has donated a valuable series of vascular plants collected by him in Juan Fernandez Islands.

SHELLS

C. Montague Cooke, Jr., Malacologist, reports accessions as follows:

"From members of the Bayard Dominick Expedition two new lots of shells have been received. The collection made by Mrs. Delila S. Gifford in Samoa, Tonga, Tokelau, and Ellice islands comprises over 2300 marine, fresh-water and land shells; from the Marquesas were received approximately 329 shells mostly land varieties including some minute material.

"In Hawaii during the summer and fall I undertook some collecting of minute marine shells. The method followed was (1) making a survey of part of the windward coast of Oahu by taking samples of sand at several different points along the shore; (2) examining the samples at the laboratory to ascertain the amount of shells present; (3) returning to the richest deposits for larger supplies of material. When sorted from the sand the shells were sent to the Academy of Natural Sciences of Philadelphia for identification. As the field of Hawaiian marine minutiae has not been overworked it is likely that new material will be found in the collection.

"Marie C. Neal, Assistant Malacologist, in company with Olga Smith, Miriam and Ella Barton, and Emma Davis, collected on Kauai a few hundred land shells, among which are some new species of much interest, as some of the material came from entirely new localities.

"The American Museum, in return for naming their collection of Hawaiian shells, offered to the Bishop Museum a selection of any duplicate material that was wanted. By this means the Bishop Museum has acquired from the Gulick, Haines, and Crooke collections rare specimens that were much needed toward the completion of the series of some of our endemic genera. The American Museum has also offered duplicates in the Coan collection of Achatinellidae which has recently come to them.

"From Henry E. Crampton were received over 300 land shells collected in 1920 and also a duplicate set of Tahitian Partulas. (See p. 210.)

"During the year negotiations were completed for the purchase of the W. D. Wilder collection of Hawaiian land shells. The collection contains excellent specimens in large series of some of the species of our Achatinellas.

"The collection of shells of the Museum has also been increased by specimens from Mr. Albert F. Judd, and Albert F. Judd, Jr., (Oahu), Mr. W. H. Meinecke (Oahu and Hawaii), Herbert E. Gregory (Maui and Hawaii), Edwin H. Bryan, Jr. (Oahu), Mr. Bruce Cartwright (Kauai), Kenneth P. Emory (Lanai), Mr. J. S. Emerson, Mrs. Charles Lucas, Mrs. Lahilahi Webb, Mr. J. L. Young and Miss L. Denne. The Albert F. Judd collection and the J. T. Gulick collection have been deposited in the Museum on loan.

"Shells were catalogued during the year as follows:

DONOR	LOCALITY	HOW RECEIVED	NUMBER OF SPECIMENS	CATALOG NUMBERS
Mrs. A. E. Moss	New Zealand	Purchase	8,862	359
Albert F. Judd	Oahu, Hawaii	Gift	108	32
American Museum	Hawaii	Gift for naming	85	49
Marie C. Neal	Kauai, Hawaii	Collected	917	154
Miscellaneous	Hawaii		31	11
			10,003	605

"A series of duplicate Hawaiian land shells, amounting to 203 specimens, was given to the American Museum to fill in gaps in their collection. Besides the marine minutiae (uncataloged) mentioned above, and unidentified specimens from the Bryan collection (cataloged and uncataloged) sent to Philadelphia for naming, duplicates of the Bryan collection (cataloged) of Hawaiian marine shells were sent to Washington for use by Dr. Dall in the preparation of a report on the Hawaiian marine mollusca."

During Mr. Cooke's absence the Museum has also received as gifts: from Mrs. Anthony Richley, 15 unidentified shells, and from Mr. Spencer Bickerton, rock containing fossil nautiloids from Australia.

ZOOLOGICAL MATERIAL

In connection with studies of marine fauna made during the year by C. H. Edmondson, the zoological collections have been considerably increased.

Of Crustacea more than 3,500 specimens were obtained on the island of Oahu at Kaneohe Bay, Kahana Bay, Kawela Bay, Waialae, Kawailoa, Pearl Harbor, Waikiki, and Kahala. The new and rare forms and representatives from new localities have been cataloged; the more common specimens and duplicates have been set aside for exchange. A representative series of Australian Crustacea has been received from the Australian Museum, Sydney, and 46 species of Hawaiian Crustacea were forwarded in return. A few specimens of Crustacea from Maleakahana, Oahu, have been received from C. Montague Cooke, Jr.

About 400 specimens of marine worms taken from the sand, coral blocks, and seaweed at Waikiki, Kawailoa, and Kahana Bay, Oahu, and approximately 150 specimens of echinoderms including sea urchins, serpent stars, and holothurians from Waikiki, Pearl Harbor, and Kawailoa have been added to the collection.

Some good examples of the Portuguese man-of-war (*Physalia arethusa*) were secured at Hauula, Oahu, and an undetermined species of Plumularian hydroid was taken from dead coral on Waikiki reef. The Plumularian is probably the first hydroid found growing in shallow water on the reefs about these islands. Two species of Bryozoa and a number of specimens of compound ascidians obtained at Pearl Harbor have been placed in the Museum.

Representatives of two species of Enteropneusta, one or both of which may prove to be new to science, were taken at Waikiki and Kahana Bay, Oahu, and two species of Enteropneusta, one from Funafuti, the other from Australian waters, have been received from the Australian Museum.

Of Hawaiian lizards ten specimens of *Lepidodactylus lugubris* (D. & B.) were taken at Kawailoa and one in Honolulu.

From other sources the following donations to the zoological collections have been received:

Aloha Temple of the Mystic Shrine, mounted king crab (*Kaempferia kaempferi*) from Japan; J. F. Illingworth, a collection made by Mr. Illingworth near Cairns, Queensland. It consists of 4 skulls and 20 embryos of the kangaroo (*Macropus agilis*), 9 lizards, 2 terrestrial leeches, skull and embryo of a bat (*Pteropus conspicillatus*), 2 skulls and 1 skin of northern bandicoot (*Perameles macrura*), and one opossum skull; David Starr

Jordan, 4 fish secured after the Alika flow of Mauna Loa in 1914 which entered the sea at South Kona, Hawaii, and a slab from California containing fossil herring [*Xyne grex* (J. & G.)]; Mrs. Anthony Richley, 9 corals and 2 alcyonarians; Mr. N. G. Smith, tailless fish (*Polydactylus sextilis*) caught off Koko Head, Oahu; Mr. J. W. Thompson, puffer-fish (Lagocephalus) from the Honolulu market; Mr. J. M. Westgate, a quantity of cephalopod eggs collected June 12 about 4 miles from Diamond Head, Oahu; Mr. M. Yamamoto, moth fish caught off Kakaako, Oahu.

There have been deposited in the Museum by Mr. Albert F. Judd, a set of mounted heads and horns of wild goat, deer, and sheep collected in Hawaii, and by Mr. S. M. Damon, shark jaws and fragments of coral.

MISCELLANEOUS MATERIAL

To the collection of miscellaneous specimens gifts have been made as follows:

Aloha Temple of the Mystic Shrine, Honolulu, German war helmet; Mrs. Anthony Richley, rhyolite vessel and collections of minerals from Arizona; Society for Preservation of New England Antiquities, through Mr. W. S. Appleton, Secretary, oil painting of Paki's home; Mr. William Wagener, 3 rock fragments containing olivine crystals.

NOTES ON COLLECTIONS

In addition to the collections in the exhibition halls a large amount of material in storage is available for study. Rooms in the laboratory are utilized for collections in anthropology, ornithology, malacology, entomology, zoology, and botany. The basement of Polynesian Hall and drawers in Hawaiian Hall accommodate the study and storage collections of ethnology.

Miscellaneous collections of the Museum including relics and unique material of historical interest have been classified and precautions taken for their preservation. The unusually fine T. G. Thrum collection of Hawaiian postage stamps, envelopes, postcards, and revenue stamps has been placed in a fireproof vault and provision has been made for the protection of the Bernice Pauahi Bishop jewelry, which has recently been examined and labeled by a committee consisting of Mrs. C. P. Iaukea, Mrs. Minnie Aldrich, Miss Jennie Parke, Miss Lucy K. Peabody, Mrs. Lahilahi Webb, and Mr. Albert F. Judd.

The collection of ethnological material purchased from J. L. Young, mentioned in the Director's Report for 1920, contains a large number of valuable and interesting artifacts. The Marquesas are well represented. Mention may be made of stone food pounders, ornaments of human hair and porpoise teeth, a fine old stone image, a tapa beater of unusual length, carved coconut cups and wooden bowls, a covered treasure box fashioned crudely in the form of a bird, a portion of a carved stone bowl, a staff of orange wood once used by Chief Moanatini and several carved paddles and war clubs.

The collection from Rapanui (Easter Island) is particularly valuable, containing a fine series of stone adzes, axes and chisels, fish-hooks of various materials among which several of stone are noteworthy, wooden tablets, stone and wooden images of men and animals, carved clubs and staves representing families, and implements of obsidian.

A series of tapas from the Marquesas, the Tuamotus, Fiji, and Samoa; 2 old wooden four-legged seats and 5 wooden drums from the Tuamotus; a girdle of black shell rings on a fiber band from the Carolines; 3 women's skirts of hibiscus fiber from Cook Islands, and a shell missile with line for catching the Portuguese man-of-war. Birds from Gilbert Islands merit record here. Other islands represented are: Tahiti, Rapa, New Britain, New Guinea, New Caledonia, New Hebrides, Penrhyn, Pitcairn, Tonga, and Hawaii.

Particularly interesting and valuable is the large collection of Hawaiian ethnological material lent by Mr. S. M. Damon. It is rich in stone implements many of which are rare and uncommon. Several of the calabashes differ from any previously received. Fishing implements and tools for making tapa are well represented in this collection.

A study of the exhibit in Hawaiian Vestibule arranged from the large collection of insects made near Cairns, Queensland, and brought to the Museum by J. F. Illingworth gives an idea of its interest. Its range, however, can only be understood when the many thousands being cared for in the entomological rooms are seen. Embryos of kangaroos and skulls of representative Australian mammals are important additions to the Museum stock of such material.

The large and varied collection of ethnological specimens made by Ralph Linton during 1920 and 1921 is evidence of the success of the Bayard Dominick Expedition to the Marquesas Islands. Supplemented by the R. L. Young Collection, it makes the Bishop Museum's material from this region unusually complete.

The contribution of a representative duplicate collection of North American insects donated by Yale University gives the Museum a valuable group for comparison. Another noteworthy accession is the collection of about 1500 mounted Samoan insects the gift of Mr. W. M. Giffard.

During his short period of active duty in January and February, J. W. Thompson made for the Museum four models of human heads, cast of a guava, and a cast of a small shark that may prove to be new to science. While on leave of absence, Mr. Thompson made an excellent cast of a puffer-fish (Lagocephalus), which he presented with the preserved specimen.

As shown by the inventory compiled during the year the Museum collections may be summarized as follows:

Anthropology		
Cataloged	350	
Not cataloged, approximate	25	375
Ethnology including relics)		
Cataloged	15,128	
Not cataloged, approximate	200	15,328
Botany, approximate		53,000
Entmology, approximate		100,000
Geology		
Cataloged	160	
Not cataloged, approximate	50	210

Malacology		
Cataloged, approximate	500,000	
Wilder Collection, approximate	47,000	
Garret Collection	8,530	
Unsorted fossil land shells, approximate	300,000	
Uncataloged land shells, approximate	500	856,030
Ornithology		
Cataloged	4,755	
Not cataloged, approximate	50	4,805
Zoology		
Porifera, approximate	75	
Coelenterata, approximate	600	
Echinodermata, approximtae	300	
Coelhelminthes, approximate	400	
Crustacea, approximate	5,000	
Other invertebrates, approximate	50	
Pisces	3,375	
Reptilia	100	
Mammalia	117	10,017
Models of zoological, botanical and ethnological specimens		1,074
Loans, chiefly ethnological specimens		1,081
Total		1,041,920

EXHIBITION HALLS

During the year a study has been made of the material on exhibition with a view to a regrouping designed to give to the exhibits a larger educational value. A beginning has been made in arranging materials to obviate the confusion of crowded cases and in providing explanatory labels.

Fifty-four plaster of Paris head casts of living Hawaiians, Americans, Japanese, Chinese, Portuguese, Koreans, and Filipinos, and of various crosses between these races were made during 1920 and 1921 by Gordon Usborne and J. W. Thompson, under the direction of L. R. Sullivan. These together with a full figure cast of David Kahanamoku were exhibited in Hawaiian Vestibule and Hawaiian Hall for a few days in July. Later these casts were sent as an exhibit to the International Eugenics Congress. (See p. 191.) A duplicate of the Kahanamoku cast stands temporarily in Hawaiian Hall.

In December an unusually interesting exhibition of economically important insects from Australia was placed in Hawaiian Vestibule. J. F. Illingworth, now of the Museum staff, collected them and with the assistance of Edwin H. Bryan, Jr., arranged them in the cases. Appropriate labels explain their relation to agriculture.

An interesting collection of Hawaiian ethnological specimens lent by Mr. Edgar Henriques has been arranged in Case 111 in the second gallery of Hawaiian Hall opposite one containing an earlier loan.

At the time of the Educational Conference in August the feather capes were specially exhibited. Members of the Pan-Pacific Press Congress visited the Museum in a body on Sunday afternoon, October 23. In preparation for this occasion a number of the feather cloaks were temporarily placed in the wall cases of Hawaiian Vestibule. Members of the staff aided Mrs. Webb in explaining matters of interest.

EXTRACTS FROM REPORTS BY MEMBERS OF THE STAFF

ARCHAEOLOGY—THE MARQUESAS

Ralph Linton, Research Associate in Archaeology, summarizes the results of his work as follows:

There are no indications of any pre-Polynesian population in the Marquesas, and the large stone structures and stone figures which occur there are unquestionably the work of the ancestors of the present natives. Dry stone masonry was highly developed and many of the *tohua* (assembly places) and *me'ae* (sacred places) are remarkable both for their extent and the size of the material employed. All the structures appear to have been either platforms or foundations for houses of perishable material, and there are no indications of vaults or, with one exception, of passages. Cut stone in the form of large rectangular slabs was used to some extent in all the islands, but is most important in Nukuhiva, the stone work showing a gradual decrease in excellence as one goes southward. Stone figures are present in most of the islands but are finest and most numerous in the island of Hivaoa. They appear to be copies of wooden prototypes. The use of stone figures as architectural decorations is well developed.

A great number of ancient sites were visited and studied, the data obtained being incorporated into an archaeological survey. In the northern division the assembly places are large and are not, as a rule, associated with *me'ae*, which are small and of simple construction, evidently modeled on the platforms used for dwelling houses. In the southern division assembly places are always associated with *me'ae*, many of which are of great size and complicated plan.

There appears to be a complete lack of stratified deposits in the group, and it is improbable that excavations of the larger sites would yield results commensurate with the labor and expense involved, and excavations would seriously prejudice the natives against future investigators.

The material culture of the group has suffered greatly from European contact, but details of most of the manufactures can still be obtained from old informants. This, combined with study of the actual objects, has made possible a fairly complete report. The culture shows an unusually high development of wood carving and stone working, coupled with a poor development of mat weaving and tapa making. The latter is especially interesting, as certain primitive implements are employed here that are rare or lacking in other parts of Polynesia. The culture as a whole appears to be most closely related to that of the Maori, the resemblance being strongest in the canoe forms and in the art. In view of the lack of data from other parts of Polynesia it is dangerous to theorize, but it seems probable that the Marquesan and Maori material culture were derived from a single ancestral type which was subsequently modified both in the Marquesas and in New Zealand. The differences at the beginning of the historic period were probably due to (a) the environment of the two peoples, which was tropical and oceanic for the Marquesans and temperate and almost continental for New Zealand; (b) the addition of new cultural elements, coming mainly from Melanesia in the case of the Maori, and from other parts of Polynesia, notably the Society Islands, in the case of the Marquesans.

ETHNOLOGY—THE MARQUESAS

Edward S. Handy, Ethnologist, has submitted the following report on the results of field work in the Marquesas during 1920 and 1921:

A series of physical measurements of 200 natives was taken with Mrs. Handy's assistance. With the observations and measurements are front and side-view photographs of each individual, and hair samples.

The ethnology of the islands was studied with the point of view not of specializing in particular phases of the local culture but of obtaining as nearly as is possible today a complete general picture of the ancient culture. The results of the work are far more satisfactory than I had thought possible before arriving in the islands. The ancient culture of the Marquesas islanders ceased to exist many years ago, but the memories of old people are tenacious and in most cases accurate. Ethnological notes brought home include a number of genealogies; some 60 chants in text, including two most interesting creation chants; about 2500 names of valleys, tribes, sacred places and deities; 34 legends and myths of which 13 are native versions in text; information regarding tribal distribution, alliance, and warfare and so on within the islands; fairly detailed descriptions of industries and organized labor, feasts and festivals; and satisfactory information regarding the religious activities and beliefs, sociology, amusements, and other matters. The organized industries, such as planting and harvesting, canoe and house building, and fishing, were found to be an exceedingly interesting field of investigation. Each type of enterprise or work has its special rules, taboos, processionals, and rites. Another most productive field of study was that of feasts and festivals. Each kind of *koina* (feast) had its special purpose, its particular order, tabus, and rites. The social system and government of the Marquesan islanders was on the whole simple, being based on the principle of family and tribal communism. The most interesting feature of the sociology is the system of secondary husbands and secondary wives which constitutes a combination of polygany and polyandry.

In addition to information derived directly from native informants, some very valuable material came to me through the generosity of the Catholic Mission in the form of manuscripts written by early Catholic missionaries.

Mrs. Handy made a very thorough study of the tattooing, which was a high art in the Marquesas, bringing back about 100 plates of accurate drawings of perhaps twice that number of designs, with data regarding their names and meanings. Such a study will be impossible a few years hence. Mrs. Handy also investigated the native cooking, recorded the processes of making more than 30 string figures, and made pen and ink drawings of most of the objects of material culture used by the Marquesan islanders.

It was brought home to me in working with the lnaguage that the orthography adopted in the grammar and dictionary of Mgr. I. R. Dordillon, commonly in use, is totally inadequate for indicating the phonetics of the language, which differ very markedly from those of the dialects of Hawaii and of Tahiti. A careful though incomplete study of the phonetics and vocalization of the dialect of the Marquesas was therefore made, which it is hoped will be suggestive to linguists.

Briefly, the results of the ethnological survey in their bearing on the ethnographic problem, in so far as definite conclusions may be stated at present, may be summarized as follows: The culture of the Marquesan islanders was basically and essentially Polynesian. There are, however, marked differences from what is usually considered the typical Polynesian complex; certain institutions are entirely or almost entirely lacking—for example, the great sacredness of the chief, and a complicated social order. On the other hand, elements are present for which we find no certain correspondence elsewhere—for example, the tattooing and carving arts. The discovery of the causes or sources of these differences furnishes an interesting problem for the ethnographist, one which will probably not be finally solved until more thorough information regarding the other regions of Oceania is available. My impression at the present writing is that in the first place the Marquesas were little influenced by some late cultural infusion that came into the more westerly groups and overlay an earlier culture; and that, on the other hand, there are strongly present in the Marquesas cultural elements which are not truly Polynesian the sources of which must be sought beyond the western limits of this culture area.

Ethnology—Rurutu and Rapa

A letter from John F. G. Stokes, dated April 15, 1921, includes the following paragraphs:

The natives of Rurutu, numbering about 1300, are concentrated into three villages. Fear of the *muti* (praying to death) greatly interfered with physical measurements but after friendly relations had been established the work proceeded satisfactorily.

The old temple sites were examined; a series of photographs of houses was made showing the transition from the ancient form to the present mortared or frame-walled structure; and moving picture films showing the process of making leaf shingles were made. Moving pictures of food preparations were taken, showing fire making with plough, oven preparation, poi pounding, coconut grating, the method of climbing the coconut palm, and two methods of breaking coconuts.

The agricultural methods have probably changed little; fishing, on the other hand, is only a partial survival of the old methods.

No tapa has been made in Rurutu for years except one piece made recently by a woman who devoted six weeks to the task. I was particularly pleased to witness the process of the work as I learned much that I had not understood before.

Games have been practically abandoned. Many of the young people knew of the string figures of which I obtained a list of 24 that were known and photographs of 12.

The genealogy of the chiefs was secured. It connects the islands of Raivavai, Tubuai, and Rurutu. These genealogies are known only to a few men and are carefully guarded on account of their value in proving land titles.

Only a few fragments of folklore were obtained, for the people look with greatest contempt on the *Etene* (Satan or heathen) period. Particulars of ancient birth customs and circumcision were learned, and of the superstitions that still survive. About 15 *himene* (songs) have been recorded on the phonograph.

Rapa appears to be the most interesting of all the islands visited. It reminds one of a crater sunk into the ocean and the sea filling the bowl. The people, numbering about 300, are concentrated in one village. The so-called forts show up very clearly on the highest points of the ridges. They appear to be places of refuges rather than forts and from the sea they look like Maori *pa.*

Fine wicker baskets of Freycinetia and tapa are still made at Rapa. Stone specimens, adzes, and poi pounders were so numerous at the time of my visit that it was evident that the island had not been previously ransacked as reported.

ARCHAEOLOGY AND ETHNOLOGY—TONGA

In a brief report by E. W. Gifford concerning his work and that of W. C. McKern, the following is included:

During the nine months spent in active work in the kingdom of Tonga, Mr. McKern and I divided the field, he taking in hand the archaeology, arts and industries of Tonga, while I handled religion and society. Frequent conferences made this scheme of work an ideal one. Each had the benefit of the other's results and no part of the field was overlooked. The work of getting anthropometric data was carried on jointly and with Mrs. Gifford's aid.

The Tongan Government gave us every aid in the work and cheerfully granted all requests and we had the whole-hearted cooperation of Colonel R. W. Tate, Administrator of Western Samoa, and of the Wesleyan Methodist and Roman Catholic churches in Tonga. Thirty-seven Tongan specimens were donated to the Museum by various residents of the Kingdom.

Perhaps the most interesting results of the expedition are those obtained by Mr. McKern, who carried on excavations at ten sites. His most startling find was that of pottery, which is not made by the Tongans of today.

Other exceptionally fine bodies of material are a 270-page genealogy of the royal and chiefly families of Tonga, a fine series of myths and tales, a large collection of medical formulas, and an exceptionally full register of Tongan place names and personal names (more than 4,000 of each), which should be of great value in settling the question of Polynesian origins. These are the richest materials gathered—the high lights that stand out from the whole mass of material covering the entire range of Tongan anthropology. No attempt was made to specialize. We tried faithfully to make a complete reconnaissance of Tongan culture as instructed.

BOTANY—THE MARQUESAS

Letters from Forest B. H. Brown, Botanist, include the following interesting paragraphs relating to his work and that of Elizabeth Wuist Brown, Research Associate in Botany:

In New Zealand and Tahiti we obtained collections and data of the greatest value bearing upon the native food, ceremonial, medicinal and clothing plants, and have about 1000 Maori and 1000 Tahitian botanical terms—a list to which we are continually adding. The breadfruits have proved of unexpected interest, the native having cultivated this plant for sufficient time and with care so that numerous varieties have been obtained by him which we find admit of clear scientific description.

Our trip through the Tuamotu group was of very unexpected interest. We visited 11 islands, obtained good full plant collections and photographs from Niau, Rangiroa, Arutua, Apataki, Toau, Anaa, Katiu, Taenga, Fangataufa, Fakaiana, and Pukapuka. The stop at Pukapuka was very unusual, extremely few people having seen this island, and we made the best of this exceptional opportunity. For a geologist, it seems this group would be of great interest, for the evidence seems to indicate a recent rapid uplift of these islands. We found a number of plants which probably date back to a period when the surface was mountainous and cloud-capped.

At Tahiti and neighboring islands we left many people searching for bread-fruits. They are greatly interested and certain to locate numerous other varieties, which can quickly be found and described on our return. The natives of the Marquesas and Tahiti actually discriminate between these numerous varieties of bread-fruit with considerably greater accuracy than can the average American agricultural college graduate with varieties of apples and cereals. I should not be surprised if my final list includes 100 varieties!

We have met M. Henry, who described the new Marquesan palm. We find the closest relative of the palm occurs in Central America and is a very close relative to the coconut—a most important bit of evidence. M. Henry has given to the Museum his original photograph of this palm and the negative.

The results of our work are most encouraging. It is probable that our enumeration of the plants of Nukuhiva alone—each with complete herbarium material—will exceed the total number hitherto reported for all French Polynesia; and the natives appear to have known and had some particular use for nearly, if not quite every one.

ENTOMOLOGY

From the report of Otto H. Swezey, Consulting Entomologist, the following has been taken:

The accumulation of Hawaiian insects collected from 1916 to 1921 comprises 16,602 specimens. Only about 3,000 specimens of this large lot of material have been determined. It has been sorted into orders and smaller groups, and awaits the opportunity of being finally determined at the convenience of those qualified to do so. As this large amount of material is greater than the Museum collection of material described in the Fauna Hawaiiensis (13,783 specimens), it is to be expected that when finally worked up, many species will be found that were not previously represented in the Museum cabinets, and no doubt a considerable number of new species will also be found.

We have the rare opportunity of obtaining insect material from Guam. Commander J. C. Thompson of the United States Navy, an enthusiastic student of natural history, has recently gone there on a protracted assignment, and has generously offered to collect for the Museum.

Mr. F. W. Christian, a missionary in the Cook Islands, has also offered to collect insects for the Museum, and has been supplied with collecting material for the purpose.

During the coming year it is hoped that field work may be done on Molokai, Lanai, or in other localities where little or no collecting has been done. Not only is collecting of specimens desired in many regions of the islands, but it is desirable that every opportunity be taken for making observations in the field on the habits and biology of the Hawaiian insects, for there are many species concerning which little is known. One much desired line of research is the study of the insect fauna of the various kinds of trees, both in particular regions and also generally throughout Hawaii. This phase will always be given attention on all field trips.

The completion of the synonymic bibliographic card catalog of Hawaiian insects is expected in 1922, with the hope that from it a bibliographic list of the Hawaiian insects may be printed.

A type register has been obtained and all "types" and "paratypes" in the collections will be entered. The Fauna Hawaiiensis collection of Hawaiian insects is largely composed of "paratypes" and these have heretofore remained unrecorded as such.

MALACOLOGY

From the report of C. Montague Cooke, Malacologist, the following has been taken. (See also p. 199.)

The collections of shells made by members of the Bayard Dominick Expedition as an incidental feature of their ethnological work are interesting and probably contain new material. But their meagerness calls attention to the need of more exhaustive conchological investigation in those and other Pacific islands, especially of small and minute land and marine forms (which are little if at all known) with material for anatomical study. Such an investigation is particularly desirable at this time when introduced plants and animals are destroying native life more and more extensively throughout Polynesia. Data about the distribution and relationship of land shells in the different groups of islands would be helpful in solving some geological problems of the former distribution and relationship of land in this region for as time goes on the amount of evidence is decreasing.

An addition was made to the Museum's supply of fossil land-shell material in September, when I discovered at Kahuku, Oahu, in a coral bluff a pocket of fossil shells. Though not occupying a space of more than a few square feet the material was so rich—about the richest I have ever seen—that many thousand specimens were taken, some of which may be new. The most noteworthy specimens were a few belonging to the genus Planamastra. This is the second record of the finding of this genus in the Koolau Mountains.

Preparatory to cataloging the Wilder Collection, Mr. Irwin Spalding, who had often accompanied Mr. Wilder on collecting trips, assisted me in working out the localities and the rather complicated system of arrangement of the shells. As a result, part of the collection is now ready to be cataloged, particularly the Achatinellidae, but much of the small material needs to be studied before entry in the catalog is possible. The collection contains excellent specimens in large series of some species of Achatinellas, and it is therefore a matter of regret that the collector left little or no record of data relating to localities.

LAND SHELLS FROM GUAM AND SAIPAN

The following excerpt is from a report by Henry E. Crampton, Research Associate in Zoology:

Earlier investigations have been concerned with the Partulae inhabiting the Society Islands, which constitute the present headquarters of the genus. The volume on Tahiti has been published, while subsequent volumes dealing with the other islands of the group are in preparation. In 1920 an opportunity was seized to make a comparative study in the Mariana Islands which lie at the extreme northwestern part of the whole range of the genus. It was expected that this investigation would prove especially fruitful on account of their distance from the generic headquarters, their contrasted ecological features, and the peculiarities of their indigenous species. Such expectations have been fully realized.

Nearly ten thousand individuals of the species of Partula were collected and properly preserved for intensive study. Thus sufficient material is in hand for a satisfactory ecological and taxonomic comparison of forms from the Marianas with the species from the Society Islands, despite the adverse weather conditions and the lack of transportation facilities which rendered it impossible to visit other islands such as Tinian and Rota. Many hundreds of land-snails belonging to other genera were also collected.

The following brief statement gives the general results:

1. The inter-island comparison of Guam and Saipan is based upon the one species that is common to the two areas, namely, *Partula gibba* Fer.

2. *P. gibba and P. radiolata,* Pfeiffer, are abundant in Guam, and their diversities have been investigated as they are displayed by the collections from 39 representative localities. Each species varies from station to station as regards the number and kind and numerical proportions of its color-classes, and is quantitatively treated in the statistical constants of the several standard characters of the shells.

3. A rare and unfigured species, *P. fragilis* Fér., has been found in Guam in sufficient numbers to afford the basis for a complete study. Appar-

ently this is the same species which was found in Guam by Quadras, and named *P. quadrasi* by von Moellendorf.

4. A new species has been discovered in Guam on the remote peak of Mt. Salifan, and on account of its locality it has been named *P. salifana*. The animals are large and well developed; despite the fact that Guam has been a well known collecting ground for a full century, they have never before been found owing to the seclusion of their habitat.

5. The question as to the causative value of the environmental influences, as contrasted with the congenital factors of differentiation, may now be answered more positively than in the case of the Polynesian material. All of the evidence proves that racial diversification in the material under investigation is due to the operation of internal or hereditary factors.

ZOOLOGY

The following interesting items in addition to collections (see p. 200) are reported by C. H. Edmondson, Zoologist:

Work is progressing on the large collection of corals in the Museum, taken in previous years in Hawaii, Palmyra, and in various localities in the South Pacific. The scientific names on the labels of many specimens of corals on exhibition in the Museum are now obsolete and the entire lot should be recataloged when the classification of the specimens has been completed.

A list of the Crustacea in the Museum collected by C. M. Cooke, Jr., at Palmyra in 1913 is being prepared for publication.

Research work at the biological laboratory at Waikiki has been progressing satisfactorily during the year. An intensive study of a section of the reef involving the ecology of the animals found within its limits has been undertaken.

Experimental work looking toward the determination of the rate and conditions of growth of coral, mollusks, crustaceans, and other marine animals is in progress. The spawning season of reef organisms is being noted and studies of embryonic and larval phases of as many forms as possible are being made. The food and feeding habits of the animals of the reef are also being studied.

Daily catches of plankton are being taken on the reef by towing between two established points with the purpose in view of determining the variation in the amount of plankton under different conditions of tide, temperature, and sunlight.

Cooperation with a number of specialists has been established by means of which assistance will be rendered in working up certain groups of Hawaiian fauna. Dr. Charles Chilton, of Christchurch, New Zealand, has been giving attention to Hawaiian amphipods, Miss Alice Robertson of Seattle, Washington, has expressed her willingness to classify the Bryozoa sent her from local waters, and Dr. Joseph Cushman, of the Boston Society of Natural History, is interested in the Foraminifera from the shallow waters of Hawaii. Acknowledgment is also due the United States National Museum for assistance in the determination of certain Crustacea from these waters.

In May, 1921, Miss Elsa Kluegel, a graduate student in zoology, completed her work on the food of Hawaiian food fishes. This work was conducted during the preceding nine months at the biological laboratory, the results being recorded in a thesis on file in the library of the University of Hawaii.

Report of the Librarian

The Librarian, Elizabeth B. Higgins has submitted the following report:

Apart from the accessioning and cataloging of books and serials as received, the library work of the year has been almost entirely the classifition, rearrangement, and card-making incident to the introduction of the Library of Congress system. In the early part of the year 106 books were bound and missing parts of current serials were sent for. From July to December with several breaks due to illness the work of classifying was carried on by Miss Driver, the Librarian giving to that part of the work only an hour or two a week for advice and consultation on knotty problems. By December, 1921, when Miss Driver's engagement terminated the most of the working part of the library was recataloged.

The accessions of the year are larger than usual as shown by the following table:

	Parts and Volumes	Pamphlets	Photographs	Maps	Manuscripts
Exchange	229	1,137	......	......	......
Purchase	166	68	50	4	......
Gifts	216	1,026	407	6	13
	611	2,231	457	10	13

The unusually large number of volumes and pamphlets received by exchange is the result of adding 29 institutions to the list of those receiving the publications of the Museum. (See p. 187.) From several of these institutions nearly or quite complete sets of their serial publications to date have been received—for example, 46 volumes and 32 parts of the Proceedings of the Royal Colonial Institute, 149 botanical and zoological publications from the College of Science, Tokyo, and 12 volumes from the Museum of Natural History at Lyons, France. Several long sets, sent through the Smithsonian Institution, arrived too late to be counted as 1921 accessions.

The new exchanges will add to the Museum library about 32 periodicals that will continue to be currently received—an exceedingly valuable acquisition. The demand for foreign scientific serials is steadily increasing as the work of the Museum develops.

For valuable gifts of books, pamphlets, photographs and manuscripts the Museum is indebted to the following:

Mr. Arthur C. Alexander, 1 manuscript; Mr. J. C. Andersen, 3 separates; Mr. W. S. Appleton, 1 manuscript and 1 pamphlet; Arnold Arboretum, 1 pamphlet; Mr. A. L. C. Atkinson, 1 manuscript; Mr. S. A. Baldwin, 27 photographs; Dr. Stanley C. Ball, 5 separates; Mr. Elsdon Best, 3 separates; Mr. Spencer Bickerton, 1 manuscript; W. T. Brigham, 15 pamphlets and 4 colored prints; Mr. J. MacMillan Brown, 6 clippings; Mr. A. O. Burkland, 17 photographs; Canadian Biological Board, 4 pamphlets; Carnegie Institution of Washington, 6 volumes; Carnegie

Institution of Washington Geophysical Laboratory, 10 pamphlets and 8 separates; Dr. Charles Chilton, 1 volume; C. Montague Cooke, Jr., 1 pamphlet; Miss Ethel M. Damon, 1 volume and 1 pamphlet; Detroit Institute of Art, 6 pamphlets; Mr. E. M. Ehrhorn, 89 pamphlets; Mr. J. S. Emerson, 3 clippings; Kenneth P. Emory, 5 pamphlets; Mrs. C. N. Forbes, 227 pamphlets; Mrs. Walter M. Giffard, 1 photograph; Herbert E. Gregory, 294 photographs, 63 volumes and 338 pamphlets; Mr. W. S. Hillebrand, 1 manuscript; Mr. Leroy H. Harvey, 2 separates; J. F. Illingworth, 9 volumes and 44 pamphlets; Dr. T. A. Jaggar, 3 photographs; Japan Imperial Earthquake Investigation Committee, 1 pamphlet; Mr. T. C. Johnston, 1 package of manuscripts; Dr. David Starr Jordan, 1 separate and 6 photographs; Mr. A. F. Judd, 29 volumes, 134 pamphlets and 3 manuscripts; Mr. C. S. Judd, 18 photographs; Kamehameha Manual School, 52 pamphlets; Mrs. John Kerkup, 1 newspaper; Mr. Charles Kofoid, 1 separate; Mr. Charles F. Kraebel, 23 photographs; Library of Congress, 4 pamphlets; Dr. Felix von Luschan, 1 volume and 6 separates; Mr. Donald Macalister, 13 photographs; Mr. Elmer D. Merrill, 2 volumes; Milwaukee Museum, 1 volume; Dr. A. Mouritz, 1 pamphlet; New York Zoological Society, 1 pamphlet; New Zealand Government, 1 volume and 1 separate; Mr. H. S. Palmer, 3 photographs; Pan-Pacific Union, 5 volumes; Mr. R. R. Parker, 1 pamphlet; San Jose Colegio de Senoritas, 1 pamphlet; Mr. E. S. Shepherd, 1 separate; Mr. Will Smithies, 1 manuscript; J. F. G. Stokes, 1 manuscript; Mr. J. Mollerup-Thomsen, 2 pamphlets; L. R. Sullivan, 1 separate; Mr. Lorrin A. Thurston, 1 separate; Thomas G. Thrum, 1 manuscript; Dr. R. J. Tillyard, 64 separates; United States Department of Agriculture, 5 pamphlets and 1 volume; United States Fish Commission, 29 volumes and 22 pamphlets; U. S. Geological Survey, 6 maps; United States Hydrographic Office (through Mr. G. W. Littlehales), 18 volumes and 10 separates; Mr. Edward P. Van Duzee, 1 volume; Miss Elsie Wilcox, 2 photographs; Yale University, 3 volumes.

Special mention should be made of the large collection of books and pamphlets and the very valuable set of photographs of Australia and New Zealand given by Herbert E. Gregory. Large gifts of pamphlets and books have also been made by Mr. A. F. Judd and Mrs. C. N. Forbes. Many valuable authors' separates and pamphlets have also been received, among them 64 papers on Australian insects, the gift of Dr. H. J. Tillyard. From the U. S. Fish Commission and the U. S. Hydrographer's Office a number of bound copies of works relating to the Pacific have been received.

The accessions of photographs by gift have been exceptionally large and a set of manuscript maps of Kau given by United States Geological Survey is particularly valuable from the ethnologist's point of view.

Some advance has been made toward a closer affiliation between the Museum library and the other libraries of the city. A number of volumes and pamphlets on subjects out of the Museum field have been transferred to the University of Hawaii, and books have been lent reciprocally by the University, the Hawaiian Sugar Planters' Association and the Museum. Several volumes have also been lent to the University of California library. A closer correlation of the Honolulu libraries is likely to be possible soon.

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THE SECONDARY XYLEM OF HAWAIIAN TREES

BY

FOREST BUFFEN HARKNESS BROWN

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In a somewhat different form "The secondary xylem of Hawaiian trees" was submitted to the graduate faculty of Yale University in 1918 as part fulfillment of the requirements for the degree of doctor of philosophy.

The Secondary Xylem of Hawaiian Trees

BY FOREST BUFFEN HARKNESS BROWN[1]

INTRODUCTION

On account of isolation in the Pacific, Hawaii has afforded exceptional opportunity for the origin and development of an endemic flora, the elements of which appear to have been contributed at different geologic periods from widely different sources. As early as 1888, a general knowledge of the flora was made available by the publication of Hillebrand's "Flora of the Hawaiian Islands" (9).

But while the floral characters were thus made known by Hillebrand and by later writers, the anatomy of the woody plants has remained to a large extent unknown. There has consequently been insufficient data by which Hawaiian woods could be classified or identified with certainty. Late in the year 1914 the Yale Forest School received from R. S. Hosmer a collection of 71 Hawaiian indigenous woods. At the suggestion of Professor Record, a morphological study of the woods of this collection was undertaken by the writer in the fall of 1916. Stained sections and macerations of each of the samples were made, and 400 slides prepared, including one complete collection for the Osborn Botanical Laboratory. New methods of technique have been elaborated; a new classification and terminology relating to vascular tissues devised, and a key has been worked out to aid in the identification of unknown Hawaiian woods.

The writer expresses indebtedness to Professor Record for many kind suggestions and criticisms in directing the work; to Professor Alexander W. Evans for criticism in the treatment of many of the difficult anatomical problems involved, and for the loan of publications; to Dr. George E. Nichols and Dr. H. N. Whitford for suggestions in the treatment of ecological problems; to Dr. G.

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[1] While this paper was being printed, Mr. Brown was absent in the Marquesas as a member of the Bayard Dominick Expedition. The editor has assumed responsibility for minor revision and for proof reading.

R. Wieland and Professor Charles Schuchert for their interest and aid in the treatment of the paleobotanical and geological phases of the problem.

PHYSICAL FEATURES AND CLIMATE OF HAWAII

Hawaii embraces a group of islands in the central Pacific Ocean in a nearly linear northeast-to-southwest series between 18° 55′ and 22° 15′ north latitude and between 154° 54′ and 160° 30′ west longitude. No other group of oceanic islands is so isolated. The distance from Hawaii to the nearest high islands is more than 1,800 miles, and 2,000 miles of water separate the islands from California, the nearest continental land. Another insular factor is the prevailing direction of the North Pacific Drift Current, which in this region flows from northeast to southwest nearly at right angles to the axis of the group and hence courses between the several islands in such a manner as not readily to transport drift material from one island to the next. However, drift material may be transported directly from the shores of Canada and northwest United States, or, indirectly, by the combined effects of the southwest winds and the equatorial ocean currents, from other portions of the American continent.

According to the latest statistics of the United States Geological Survey there are nine islands in the group with an aggregate area of 6,406 square miles, an estimate which does not include the thousands of islets in the Hawaiian Bird Reservation. The island of Hawaii, with an area of over 63 per cent of that of the group, is slightly smaller than the State of Connecticut. In order of position west from Greenwich the inhabited islands are Hawaii, Maui, Molokai, Lanai, Oahu, Kauai, Niihau, and Midway.

The islands are dissected volcanoes with altitudes of nearly 14,000 feet, reaching above the snow line, and have therefore a highly varied mountain climate not possessed, to the same degree, by any other of the Pacific islands.

Associated with the mountainous topography, extreme variations in precipitation and humidity occur within a few miles. The northeast trade winds, which blow almost continuously, are cooled in their upward course over the mountain and precipitate a large part of their moisture on the northeast (windward) side of the islands. The corresponding leeward side receives, in consequence, a less amount of rain. For example, the windward side of Kauai receives, in places, as much as 500 inches annual precipitation, and hence a bog flora is developed. On the leeward side of this island, less than 21 inches of rainfall was recorded for the same period; here the relative humidity is less, and the vegetation correspondingly xerophytic.

Rainfall increases with elevation from the coast to about 4,000 or 5,000 feet altitude, and decreases from this point upward. Summits of 10,000–14,000 feet receive very little rainfall. In the cloud belt, 2,000–8,000 feet, the annual rainfall is seldom less than 200 inches, giving a rainy zone in which the native forest reaches its best development.

The distribution of rainfall throughout the year may be nearly uniform, as in the belts of incessant rain of the bog areas, or may show a seasonal variation, corresponding to a more or less pronounced rainy (winter) season and a correspondingly dry (summer) season. In some portions, as on the coastal plain of Honolulu, such seasonal variations in precipitation are well marked and probably correlated with the formation of growth-rings in woody stems. In other portions, as on Mount Tantalus, Oahu (2,018 feet), the precipitation is greater and more evenly distributed throughout the year, and is apparently without seasonal variation sufficient to cause the formation of structural growth-rings.

The relative humidity is low in comparison with other Pacific islands, being about 75 per cent at Honolulu. It is less on the leeward side than on the windward side. In the cloud belt it is high and may reach a nearly continuous saturation, as in the bog areas. On the high summits above the cloud belts, the air is clear, the insolation intense, and the relative humidity about 50 per cent.

The mean annual temperature of Hawaii is about 70° F., and there is a fall of about 3° F. for each 1,000 feet of elevation. The estimated mean annual temperature of the zone in which the best forest growth occurs, 4,000–6,000 feet elevation, is therefore between 63° F. and 57° F. On the high summits snow falls in winter, and the night temperature drops below freezing throughout the year. While variations of more than 30° F. may occur between night and day temperatures, marked seasonal variation in temperature is lacking. The mean winter temperature may be only 5° lower than the mean summer temperature, a difference probably too small to exercise any appreciable influence on plant growth.

The light intensity is greatly reduced by the presence of clouds, fog, misty precipitation, or rain, and it is probably because of the low light intensity thus caused that the slow growth and low stature of the Hawaiian trees are chiefly due. (See p. 218.)

Edaphic conditions independent of topography are apparently more uniform than any other environmental conditions. The soil throughout Hawaii is mainly derived from the decomposition of basaltic rock; it is claylike and generally pervious to water. Coral sand is formed at the beach, and dunes of coral sand are formed in places. Physico-chemical factors are therefore comparatively constant, except in the narrow littoral zones where calcium carbonate originating from coral is present, together with sodium chloride and other material from the ocean. It is also possible that sea salts are carried inland by the winds to moderately high levels.

FLORISTIC COMPOSITION AND AFFINITIES

ENDEMISM

The wide range of conditions prevailing more or less over each island, together with the extreme isolation of the group, has been favorable for the development of a varied flora richer in endemic species (9, p. xv) than that of any other land. Numerous groups composed of closely related (endemic) species are present, the lineal descendants, in all probability, of a single ancestral immigrant. But the groups are only distantly related, and constitute a heterogeneous whole. Probably the factor which is responsible for the heterogeneity of the groups is the number of sources and climates from which the flora has been derived. Hillebrand (9, p. xvii) recorded a total of 705 species of angiosperms, of which 574, or 81 per cent, are endemic. Guppy (6, p. 232) later places the number of endemic species at 546, and the indigenous at 686, or 80 per cent endemic. Of the 216 species of indigenous trees recorded by Rock (18), 93 per cent are endemic.

Wallace, observing the high endemism in the fauna and flora of Hawaii, assumed a great antiquity both for the age of the flora and for the age of the islands. We find the words: "These facts undoubtedly indicate an immense antiquity for this group of islands, or the vicinity of some very ancient land (now submerged) from which some portion of their peculiar fauna might be derived" (23, p. 326). Hillebrand (9, p. xviii), believed the difference in endemism in the islands might be related to the progressive age of the Hawaiian islands in order from east to west. Sinnott and Bailey (20, pp. 574-575) remark: "Such a high degree of endemism seems clearly to imply great antiquity." But Guppy (6, p. 248) says: "This great preponderance of peculiar [endemic] species and genera in Hawaii is not to be connected with the relative antiquity of the group, but with its degree of isolation." Guppy uses the term ancient in this connection in the same sense that the endemic forms of Hawaii are relatively older than those which are nonendemic; or, in other words, the endemic element indicates, primarily, what forms came first and have therefore been longest on the Islands. His meaning is clear, where, speaking of endemic genera (6, p. 261) he says: ". . . on one point there can be but little danger of going astray, namely, in imputing to them a high antiquity in the floral history of Hawaii."

The evidence gathered in the microscopic examination of Hawaiian woods, especially in the size of the vessels, likewise points to a great antiquity. The vessels of all the species belonging to the endemic series are of exceptionally small size (average of 71 species, 0.13 μ in diameter), rarely exceeding 0.15 mm. in diameter, or less than one-third that often exceeded by vessels in such temperate continental types as *Quercus rubra.* The vessels of many continental tropical or subtropical woods, such as Eucalyptus, often exceed this size. Introduced species, such as *Terminalia catappa,* have comparatively large vessels; and even the species of evidently recent geological acquisition, such as *Rhus semialata* var. *sandwicensis,* have likewise large vessels. It would therefore seem as if smallness in the size of vessels has been the result of a slow evolution in response to a generally humid climate in which transpiration is relatively slow.

Furthermore, Hillebrand has shown that there are no gymnosperms of any kind upon the islands and observes (9, p. xxx): "Absence of gymnosperms militates for the view that the islands were formed subsequent to the age in which these were universally distributed." Since the green cones of all species examined by the writer sink in water, and since the seed is ill adapted to resist the effect of sea water, it is more probable that these plants are not adapted for dispersal over long stretches of ocean.

When the age and affinities of the species and genera are considered, the flora of Hawaii is found to consist of at least two main groups, very distinct from one another. The first and evidently the most ancient group, consisting of endemic or near endemic genera with well-differentiated species, and comprising 322 species or nearly one-half of the total indigenous flora, seems to be entirely an American derivative. The second and next in point of age, consisting of species belonging to nonendemic genera, is partly American, but mainly Malayan or Australasian. The third and last, the most recent group, consisting of nonendemic genera, is predominantly Malaysian or Australasian.

THE AMERICAN ELEMENT

The first group, representing the American component, is plainly the most ancient, since it consists of endemic genera with will-differentiated species. It is characterized by Compositae and Lobelioideae, which alone are represented by 109 species, nearly all of which are woody. There are no other plant families with so many representatives. Of these two, the Compositae stand first. All of the endemic genera of this family typified by *Dubautia* and *Raillardia,* show American affinities centering largely about Central America. One genus, Hesperomannia, is of particular interest, for it shows a Brazilian affinity. Concerning the Lobelioideae, all of which are woody, Drake del Castillo (6, p. 254) is quoted: "These plants connect Hawaii with America just as the Goodeniaceae link the same group [Hawaii] with Australia. This is what we might have expected, since the center of the order is in America principally in the Mexican and Andine regions." The main endemic, or near endemic, genera of trees belonging to this group, and contemporaneous with the Compositae, are Dubautia, Raillardia, Hesperomannia, Clermontia, Cyanea, Platydesma, Nothocestrum, and Charpentiera. Nothocestrum (Solanaceae), with its four endemic arboreal species, is of particular interest, for it is believed (18, p. 417) to be most closely related to the Brazilian genus Athenaea, a genus with 14 species peculiar to Brazil. The evidence is supported by the fact that the center of distribution of the Solanaceae is in Central and South America. We have thus a second instance in which Brazilian affinities are plainly indicated.

The next group, with 103 species, evidently represents a slightly later stage in the floral history of the islands and is made up of near endemic genera. Both American and Old World affinities are indicated, but the Old World affinities are doubtful. As with the first series, American affinities are mainly if not wholly represented. This group seemingly represents a transition stage between the first and last groups. The main genera of trees are Pelea, Broussassia, Cheirodendron, Triplasandra, Pterotropia, Gouldia, Bobea, Straussia, Labordea, and Notrichium.

In summary, the highly endemic element thus described, or the most characteristic portion of the Hawaiian flora, indicates, in all probability, the portion which was first to arrive on the Islands. It was derived largely from the South and Central American region, particularly from at or near the isthmian portion, though to some extent the Brazilian and Andine portions of South America, and possibly North America, are indicated. In the latter part of the period, as shown in the second group, Austro-Malayan plants begin to come in. It is of interest to note that while no trees of high commercial importance belong to this period, more than 91 per cent of the species (9, p. 574) are more or less woody. All are interior plants and many occur at high levels.

THE INDO-MALAYAN ELEMENT

The somewhat larger remaining portion of the Hawaiian flora, comprising approximately three-fifths of the whole, is evidently of comparatively recent origin, as indicated by the fact that though the species are largely endemic, the genera to which they belong are represented by some species which occur outside the group, or the genera are nonendemic. In contrast to the earlier element, which was seen to be an American derivative, this latter element is largely Indo-Malayan or Australasian in its affinities, but in all probability these plants are of American origin. A somewhat larger portion of this element is composed of herbaceous species, but the commercially important timber trees all arrived in this period. A few of the trees, as Sophora, Myoporum, and Cyathodes, occur at high elevations, but the majority, such as Pittosporum, Sapindus, Reynoldsia, Gardenia, Psychotria, Phyllanthus, Elaeocarpus, Dodonea, Metrosideros, Alphitonia, Pisonia, and Acacia, are more characteristic of the lower levels.

AGENCIES OF DISPERSAL

The double affinity—American and Indo-Malayan—indicated in the flora of Hawaii is perplexing and presents a problem which, up to the present, seems not to have been solved, though the possibilities of agencies of dispersal, such as winds, birds, and ocean currents, have been considered in detail.

Wallace considers that winds may have played an important part in the transfer of seeds—an idea supported by the known distances to which small particles like volcanic dust have been carried by the winds. But a large number of the seeds of the early Hawaiian flora, such as the berries of the Lobelioideae, seem unsuited to be transported long distances by this means. Furthermore, the winds, because of their prevailing direction, would, if effective, seem likely to bring seeds from near the Canadian portion of the North American continent—a section scarcely represented in the Hawaiian flora.

Wallace (23, p. 325) mentions two local elevations in the ocean bed between San Francisco and Hawaii which may mark the past location of two small islands which served as a "stepping stone" from the American continent. The main difficulties of such an assumption lie in the fact that it is hard to conceive of any agencies that would be likely to transfer life from such places as Mexico, Central America, and especially Brazil, to such a station as would be demanded by the floral affinities. Even granting such a possibility, additional difficulties are encountered in explaining how such forms would then reach Hawaii to the exclusion of others.

Pilsbry (16, p. 431) cannot escape the conviction of the past existence of a land connection to the continent, to account for the presence of certain families of snails in Hawaii and other Pacific islands. The fact that the contour of the Pacific Ocean bed discloses only a series of mid-oceanic ridges running northwest-southeast—in just the opposite direction from that of the adjacent continents, Asia and Australia, and that between those ridges occur great ocean depths precludes any possibility of there ever having been such a land connection.

Guppy (7, p. 250) disagrees with Wallace with respect to the effectiveness of air currents in seed transportation. He observes: "I am not inclined to think that, except as regards the spores of Cryptogams, winds have done very much for Hawaii." He emphasizes the probable agency of birds and indicates the very numerous means by which seeds may become fastened to their plumage or feet, in addition to passing unharmed through the digestive tract.

Among the difficulties occurs the fact that, as in the case of the winds, such agencies fail to account for the development of numerous endemic forms, and it becomes necessary to make a second assumption, as is done by Guppy (6, p. 263), where he explains that the means which enabled such agencies to be effective in the transport of seeds to the islands were suppressed upon arrival. Thus seeds which possessed hooks or barbs at time of transportation gave rise to species with barbless seeds; similarly, thick-coated seeds, which would pass unharmed through the digestive tract, gave rise to thin-coated seeds; and so on. The almost visionary character of such reasoning merely demonstrates the greatness of the difficulty which naturalists, from Wallace's time to the present, have encountered in explaining the sequence of the eastern and western affinities of the Hawaiian fauna and flora.

Such birds as the plover, which occur also on the coast of North America, and the tropic bird Phaëthon have been mentioned in connection with the dispersal of species (18, p. xxx). But it is difficult to understand how such agencies could be very efficient in the dispersal of seeds over long distances, since such birds prey upon fish and other animal food, as do practically all sea-going birds. Birds that make long flights arrive in a lean, fatigued condition, the digestive tract empty. Also, seed would need to be fastened with exceptional firmness to resist the long action of wind, and probably of rain and water, over the long stretch of ocean, not to mention the care which birds exercise in cleaning their plumage.

The probability of bird agency, then, in such long-distance transportation of seeds as from the American continent to the Hawaiian islands would seem to be slight, if not negligible.

The efficiency of ocean currents in the transportation of seeds has been variously estimated, both from experiment and from observed data (6, p. 66). The rate has been determined by bottles set adrift in a given current. Five miles a day seems a conservative estimate, though an average rate of as high as 40 miles a day for a distance of 1,000 miles was obtained in the main equatorial current off the Amazon estuary, in the direction of Trinidad. We shall see that this marked drifting toward Trinidad has an especial value in the explanation to be offered later on.

Guppy (6, p. 92) found that of 16 common cosmopolitan beach plants all had buoyant seeds, and all possessed structural specializations by means of which they could be transported in the equatorial current from west Africa to Brazil in a sound condition. Some seeds, as *Thespesia populnea,* can float a year in sea water without loss of germinative capacity. Many varieties seem adapted for long-distance transport, and if carried by such natural rafts as floating logs would, especially if kept reasonably dry, be likely to retain their germinating power for very long periods. Becquerel (1) found 20 specifically different kinds of seed which germinated 28 to 87 years from time of collecting. It is interesting to note, in this connection (5, p. 8), that 14 years after the destruction of all life on the volcanic island of Krakatau, 53 phanerogams had reached the island, from which it was estimated that 60 per cent had arrived by ocean currents, 32 per cent by wind agency, and only 4 per cent by fruit-eating animals or by man. From such data, ocean currents, as compared with other agencies, would appear to be by far the most efficient agency in the dispersal of the seed-bearing plants.

The possibilities of birds, winds, ocean currents, "stepping stones," and land connections have been considered without success so far as arriving at any conistent solution of the problems involved in the origin of the Hawaiian forests. None of these agencies explains an early dispersal of plant life from the American continent to Hawaii, nor why such migration should practically cease, to be replaced by the later dispersal of life from Australo-Asiatic sources.

Ocean currents have been considered as, on the whole, the most probable agency, but the existing ocean streams which come in contact with the American continent afford no opportunity for species from the central and southern portion of the continent, especially Brazil, to be brought to Hawaii. Furthermore the fact that the westward dispersal of American plants was completed in some past geological epoch is obvious and also that an explanation calls for an understanding of past rather than of present conditions. The American elements in the Hawaiian flora could be accounted for on the assumption that at some previous time westward-moving currents had been brought in contact with isthmian and South American floras.

It was therefore gratifying to find geological evidence on which to base such an hypothesis. Professor Schuchert (19) has shown that in late Eocene and throughout Oligocene time both the Isthmus of Panama, including most of Central America, and the Isthmus of Tehuantepec were beneath the sea. The Caribbean Sea then united the Atlantic and Pacific oceans. Some time after the Oligocene, probably in late Miocene time, this portion of the continent emerged, closing both openings then and apparently forever since.

Such conditions furnish the data anticipated as necessary for the solution of the problems relating to the origin of the Hawaiian flora.

It is easy to see that the rapidly flowing Atlantic equatorial current, passing over the wide open Central America, would have carried drift into the Pacific in a wide, fan-shaped path toward

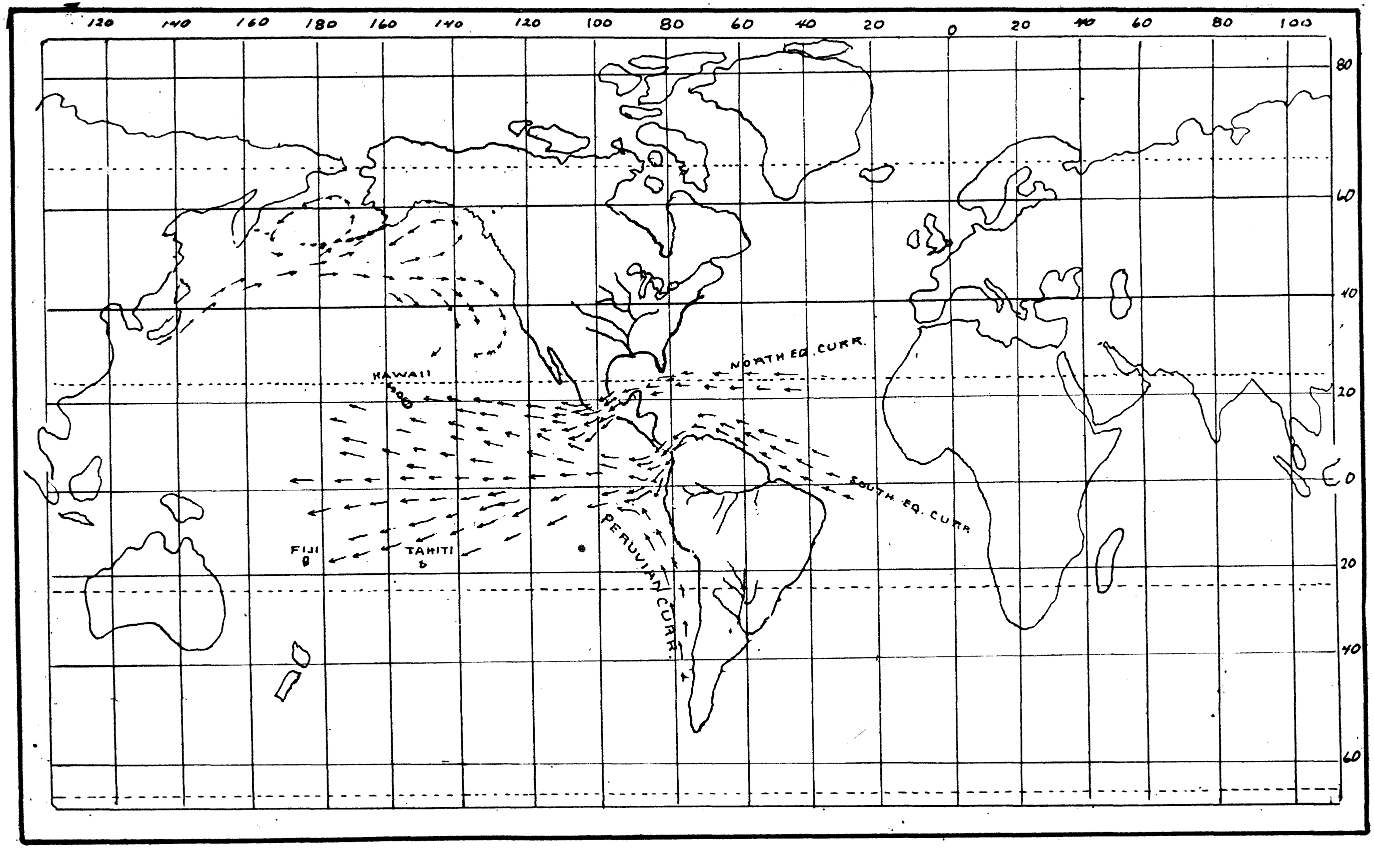

FIGURE I. Chart showing probable floods and changed oceanic currents of late Eocene and early Oligocene times.

Hawaii and other Pacific islands. It is likely that the Pacific currents were so changed, possibly somewhat in the manner shown in figure 1, as to facilitate a direct transfer of material by ocean currents. The Amazonian drainage, flowing directly into the equatorial current, would contribute Brazilian drift. Assuming now that Hawaii had emerged in Middle Tertiary time—an assumption quite in keeping with the volcanic origin and high protuberance of the islands—it is difficult to conceive how such land would escape being colonized by American plants. Probably the coconut came in this period. Furthermore, it is plain to see why plant dispersal should have ceased with the permanent closing of both openings in the Oligocene. It is also apparent why in the following period, at the time of emergence of the smaller islands of the west Pacific, plant dispersal should have proceeded to the westward, the nearness of small islands affording a more direct path for animal agencies in that direction than could be found to the eastward. Probably birds were then the active agents, since the direction of both air and ocean currents would now seem comparatively unfavorable.

If 1,500,000 years be the least length of time of the Eogenic, then about 750,000 years may have passed during subsidence, and twice as long since then during the emergence of Central America. It is likely that the Central American lowlands were first flooded, during subsidence. With continued subsidence, the zone of the Lobelioideae would be reached possibly at the time the waters commenced to flow over the peninsula. The Lobelioideae, then, would be the first element to arrive on the Islands. This may explain the peculiar ancient appearance noted by Rock (18, p. 489) and others in the members of this tribe. The composites, occurring at higher levels, would follow the Lobelioideae. The two elements being the first to arrive upon the islands, or the most ancient in the floral history, the species have become most modified of all. They are hence represented by endemic genera, of which there are 158 species.

It is particularly interesting to note that at the first stage when plants begin to arrive from the west, the drupe appears for the first time in Hawaii. In this transition group there are 19 species whose fruits are small drupes. All evidence strongly suggests the agency of birds as a leading factor in the dispersal of plants from the Old World. With the emergence of the Isthmus in late Miocene time, the Caribbean current would cease and so the drifting of seeds or seed-bearing material from the American continents. Hence but few American elements are present.

The final group, which is more recent as indicated by the absence of endemic genera, as well as the comparatively slight differentiation of its species, may be termed the post-emergence group. It followed the closing of the openings at the Isthmus, and has come largely from Indo-Malaysian sources. In all probability, the first two groups, particularly the first, arrived in comparatively short time. The third or more recent group probably made its appearance gradually, in keeping with the known slowness of animal agencies (7, p. 8), particularly over long distances of the ocean, and probably has been more or less continuous from the date of the emergence of the islands of the west Pacific up to the present time.

In the first group, it is probable that some forms arrived which are not endemic. The coconut palm has been placed in this group. It seems well substantiated that the coconut palm (*Cocos nucifera*) must have originated at or near the isthmian portion of the continent. Hillebrand (9, p. 452) quotes Martius, who places the original home of the coconut in the western border of the Isthmus of Panama. More recently, Cook (2, pp. 338-339) suggests the interior valleys and plateaus of the Andes in northwestern South America, since all other species of the genus Cocos are natives of this region.

But both Hillebrand (9, p. xvi) and Cook (2) suggest the agency of primitive man in its introduction. Cook asserts that the short-lived quality of the coconut seed (p. 326) and the inability of this palm to endure shade (p. 299) would make it impossible for it to establish itself on any coast, and states (p. 296) that the "coconut palm is not known to exist except as a cultivated plant on any tropical seacoast . . . (p. 297). We should find on some tropical coast a place where the palms thrive and multiply, where we find old palms surrounded by flourishing young ones, growing spontaneously, without aid of man, but no such instance has been reported." Finally he adds (p. 349): "The theory that it has been disseminated by ocean currents is gratuitous, unproved, and improbable."

Unfortunately, each of the above statements which underlie Cook's whole hypothesis, and which seem insufficiently substantiated, is contradicted. Guppy (6, p. 435) personally observed the germination and development of the coconut palm from drift seeds on the Fiji coasts. Furthermore on the volcanic island of Krakatau (5, p. 30) the coconut appeared thirteen years after the destruction of all life on the island, on the shore, in the strand forest, and some distance inland. The plants of the interior forest were in full fruit, and seedlings, some a meter in height, were growing from the nuts which had fallen from the trees to the ground, so that a renewal of the forest was thus amply provided for. Thus Cook's statements seem to be without sufficient foundation.

Given the presence of the coconut in condition and climate where single trees produce as many as 200 seeds, within reach of the swift inundating currents of the Tertiary floods, the chances are highly probable that coconut fruits would be carried uninjured even as far as Hawaii. The great variation conceded for the coconut palm (2, p. 322), of which there are numerous varieties, would itself argue for a corresponding variation in seed vitality. Since available data and investigations are at present in disagreement upon this point (3, p. 923; 15, p. 325), the necessity for further investigation is apparent. Such experimental work should be extended sufficiently to include all the varieties, together with sufficient material of each to consider, as far possible, the numerous possibilities before such data can be regarded as conclusive. From present data, it may be stated as probable that, with such conditions as have been indicated for the Eogenic, the coconut was disseminated over the Pacific even as far as Hawaii.

Another plant which may have been established upon the islands during the period of submergence is *Batis maritima,* a monotypic species which, outside the Islands, is only recorded on the West Indies, the west coast of Mexico, and Lower California.

The evidence pointing to the altered condition of the oceanic streams is not confined to plants. Pilsbry (16, pp. 429-433) mentions the greatly specialized but primitive groups of land snails inhabiting the forests of Hawaii and other high islands in Polynesia. The westward extension of this fauna stops at the Fiji Islands. On the continents such groups were prevalent before the Eocene, but have now been almost entirely supplanted by the modern families of snails. At the same time, the modern families (Helicidae) are absent from the islands. Pilsbry remarks (p. 431): "If Pacific faunas were derived . . . from waifs drifted thither on 'natural rafts' or carried by birds from the continent, such migration must have stopped as an effective factor . . . before Tertiary times, for all dominant Tertiary snails of the continents are absent, as, with our present knowledge, they appear to be." He concludes that some land connection between the Pacific and the continent must have existed in the past in spite of the fact that it is "heterodox to doubt the absolute permanence of oceanic basins."

It is obvious that the same agency which transported the seeds of the early Hawaiian flora could have at an earlier date carried the land snails that inhabited the forests of that period. The Central American area was open in Lower Cretaceous–Jurassic times, and may account for an early transfer of snail fauna, though it is not apparent why the more modern families were not brought over in the Eocene. It is possible either that by further exploration the more modern groups of snails may yet be found, or that more complete evidence may enable one to determine more definitely the age of the floral elements. There seems no reason why the two lines of evidence may not be brought into agreement. Such data would seem to have particular bearing in suggesting the existence of drifting material, or "natural rafts," upon which seeds as well as snails would have been transported. Of added interest is a group of small land snails adapted to the conditions of and prevalent in the insular coconut groves, hiding under leaves and wood, to which they stick fast in dry weather. There are 800 species of them in the Hawaiian islands. Yet in spite of the fact that they "seem particularly adapted to flotsam,

. . . even they fail on the more outlying islands." Such facts would seem to relate the action of the Tertiary flood directly to the continental coconut forests.

In summary, the differences in endemism noted in the different elements of the Hawaiian forests are apparently related to the relative antiquity of such elements. The most ancient as well as characteristic component seems to have arrived in the Middle Tertiary, or even in earliest Cretaceous time, largely by way of the isthmian portions of the American continent, by agency of the trans-isthmian ocean currents prevailing at that period. Brazilian and Andine elements, contributed by the Atlantic equatorial and the Peruvian currents, respectively, arrived at the same time. Subsequently, commencing with the closing of the two gaps through the Isthmus, and the emergence of the islands in the west Pacific, plant dispersal through the agency either of birds or of oceanic currents, or both, began and came to predominate from the west—mainly from Australo- and Indo-Malaysian sources. The commercially important timber trees arrived during this last period.

An exceptionally large proportion of the Hawaiian plants, particularly those belonging to the early group, are woody. This may, at least in part, be the result of generally favorable conditions for forest growth, together with the absence of such destructive agencies as browsing reptiles and other wood-chewing animals. Another view has recently been advanced, namely, that the Hawaiian vegetation may be a relic of past conditions in which woody plants were universally more common than now (20, pp. 547-600).

MATERIALS AND TECHNIQUE

PREPARATION OF MATERIAL

By reason of the wide range of variation in hardness, and in mineral or resin-like contents of the different Hawaiian woods, it has been necessary to adopt special methods in the preparation of tissues for microscopic study.

Thomson's modification of the Jung-thoma sliding microtome with a Walb blade, 170 mm. in length and 35 mm. wide was used in sectioning. The knife was so sharpened as to give a wedge-shaped edge, of which the two planes were inclined at an angle of 20 degrees to each other. Perfect axial alignment of the cutting edge was obtained, then the blade so inclined downward as to give an angle of 4 degrees between the section surface and the lower plane of the knife wedge. The knife carriage was so revolved as to give an angle of 7 degrees to the direction of movement, in order to secure the thinnest sections. Carefully prepared material could then be cut to a thinness of 2½ microns.

The wood was cut in blocks with a radial surface of 8 mm. vertical height, 2 cm. radial length, and 8 mm. of tangential thickness. Air was abstracted as far as possible from the cell-lumina by alternate boiling and cooling, together with the use of an Eimer and Amend aspirator, No. 3250.

The blocks were then placed in a paraffine cup and covered with strong hydrofluoric acid for a period varying from three weeks to six months, the time being determined by removing blocks at intervals of three weeks and testing with a sharp scalpel until they were sufficiently soft to cut well. No injury is done the tissues by remaining a long time in the acid, and strong acid always gives best results. The blocks were then washed in running water for four days to remove all acid, then covered with glycerine until wanted for sectioning. Cross sections were cut 0.01 to 0.015 mm. in thickness; radial sections, 0.008 to 0.02 mm.; the tangential, 0.007 to 0.008 mm. When cutting the blade was wet with 70 per cent alcohol. The sections were removed with a fine brush and transferred to water.

STAINING

After washing in at least three changes of water to remove glycerine, the sections were covered with 2.5 per cent solution of iron alum for five to twelve hours, then washed in running water for five minutes, then covered with 5 per cent aqueous solution of haematoxylin for twelve hours, then washed in water for three minutes, then covered with iron alum solution until the sections became light gray, then washed in running water for three hours, then stained in one-half alcoholic and one-half aqueous solution of safranin for two hours, then washed in 96 per cent alcohol, dehydrated, covered with xylol, then mounted in damar.

INDEX OF REFRACTION OF MOUNTING MEDIA

Stained sections were found satisfactory for most of the work, but some of the minute details were obscured in staining—a process which depends for clearness mainly upon color contrasts. Minute pits, such as occur in some of the membrane-walls, are often not differentiated by color. It was found that if such tissues were left unstained and mounted in some clear medium whose index of refraction differed as much as possible from that of the membrane wall, the greatest minuteness of detail was obtained. The following media are arranged in order of their refractive properties:

(1)	Water	index of refraction,	1.33
(2)	Styrax	" " "	1.38
(3)	Glycerine	" " "	1.46-1.47
(4)	Damar, balsam	" " "	1.52
(5)	Balsam of Tolu	" " "	1.628
(6)	Mono-bromide of napthol-naphtalene alpha mono-bromated	" " "	1.65
(7)	Tolu dissolved in naphtalene alpha mono-bromated	" " "	1.7 ?
(8)	Quinidine (melts above temperature of water)	" " "	1.8 ?

Unstained sections of woody tissues mounted in glycerine and cemented with Brunswick black were found more satisfactory for many purposes than stained sections, particularly in observing the pitting of fibers and vessels.

MACERATION

Many of the tropical woods contain resin-like, gumlike, or other substances in the ray-cells, vessels, and other elements, by reason of which details of pitting and other features are obscured. Macerations were found satisfactory in treating such woods, and the following method was adopted in their preparation. The pieces found most satisfactory were cut to expose a radial length of 2 cm., an axial length of 1 cm., and a thickness of 2 mm. These were first boiled in water for an hour, then allowed to stand and cool. Alternate cooling and boiling periods were continued for at least five changes, then as much potassium chlorate was added as could be taken upon a small knife blade, then the pieces of wood were covered with 50 per cent nitric acid and heated to boiling. A water bath capable of receiving twenty test tubes was found especially convenient. After the pieces whitened and commenced to fray, cool water was added, causing the macerated material to settle, then changed to clear water and allowed to heat again to remove the acid. The material was then transferred to a watch glass and teased apart by a small-sized artist's bristle brush. The water was then removed by a pipette, changed several times, and the maceration covered with 96 per cent alcohol and allowed to stand thirty minutes, or until all air had been removed from the cell-lumina. The alcohol was then removed, the material covered with a 2 per cent solution of Bismarck brown in a 70 per cent alcohol, and allowed to stand for 12 to 24 hours. After washing for a short time in alcohol to remove excess stain, the macerated material was mounted in glycerine and cemented with Brunswick black. Such preparations were found to be of especial value in determining the details of vascular anatomy.

DESCRIPTIVE CLASSIFICATION OF PITS AND PERFORATIONS

Many of the terms applied to the pits of plant-cells, and in current use, are often confused or inaccurately or loosely applied. For example, the term "pit" has been defined as a structure peculiar to a single cell. An isolated tracheid, accordingly, is described as having pits. Consistently, the bordered structures communicating between tracheids should each be considered as made up of two pits, one belonging to each tracheid. In such connections terminology is seldom employed with the discrimination essential to clearness, and confusion has arisen. For example, the term "semi-bordered" or "half-bordered" is applied to the intercommunicating structures between vascular elements and parenchyma, where the pit-canal in the vascular element is bordered, while on the opposite side of the closing membrane the canal is open. Such terms are confusing if the double nature of such pits is accepted.

The restriction of the term "pit" to the intercommunicating structure between the two cells might seem justified from the fact tha the closing membrane has, in an increasingly large number of wood specimens been shown to be perforate. Strands of protoplasm (21, p. 686), or "protoplasmic bridges," pass through such membranes, except, possibly, in gliding cells from one cell to another. Liquids, in passing through such structures, must enter at one orifice and pass out at the other. Thus the two orifices are functionally different. The action of one orifice is dependent upon the presence of the other, and ceases to function as soon as one is separated from the other; the two are thus a physiological whole. The so-called pits of isolated fibers, tracheids, vessels, and other elements, as in a maceration, are therefore the separated portions of pits for which the term "pit markings" is here employed.

But other pits, such as sensory pits and ray pits communicating with intercellular spaces, are peculiar to a single cell. A distinction must therefore be made between pits peculiar to a single cell and such pits as are common to more than one cell. Accordingly, the following classification of pits and perforations has been devised and used in the accompanying descriptions:

PITS

A pit is a modified portion of a cell-wall by means of which, or through which a cell is in communication with the exterior, or with an intercellular space, or with other cells. It is distinguished from a perforation by the presence of a closing membrane, which, however, may have, or possibly always has, minute perforations. They are of two main kinds: uniportal and biportal.

Uniportal pits have a single orifice. Such pits are peculiar to a single cell, i.e., are cell-pits, and are structures by means of which a cell is in communication with the exterior or with an intercellular space, but not with another cell. Examples are sensory pits, ray-pits communicating with intercellular spaces, and pits communicating with resin canals or secretory cavities.

Biportal pits have two orifices. Such pits communicate between cells—hence in a sense are tissue pits, and belong to three different classes, based upon the shape of the pit canals and orifices: (1) Simple pits, in which neither side is bordered—pits between parenchyma cells are usually of this kind, (2) half-bordered or semi-bordered, and (3) bordered.

The half-bordered or semi-bordered pits, bordered upon one side only, are of four different kinds:

(a) Annular, in which the orifice of the bordered side, the closing membrane, and the orifice of the unbordered side, are approximately circular in outline. Pits between vessels and adjacent ray- or wood-parenchyma cells in *Platydesma campanulatum* are typical examples:

(b) Piceiform, in which the orifice on the bordered side is lenticular, while the closing membrane is circular, or nearly so, in outline. Pits between ray-parenchyma cells and adjacent tracheids of Picea and many of the nut-pines are typical.

(c) Long piceiform (piceiform pits with extended slits), in which the bordered aperture possesses a slitlike orifice extending beyond the closing membrane.

(d) Scalariform, in which both the orifice and the closing membrane are linear and parallel.

Bordered pits are those in which borders are formed on both sides of the closing membrane. Four main types are recognizable, based on the shape of the orifices and closing membrane.

(a) Annular, in which the orifices and closing membrane are circular in outline. Pits in the early-wood tracheids of *Pinus strobus* are of this kind.

(b) Taxiform, in which the orifices are lenticular, oblique, and crossed, while the closing membrane is circular, or nearly so, in outline. Pits in the early-wood tracheids of Taxus are mainly of this kind.

(c) Long taxiform, which resemble taxiform pits except that each orifice is extended beyond the closing membrane to form crossed slitlike orifices. Pits in the late-wood tracheids of Taxus are of this kind.

(d) Scalariform, in which the orifices and closing membranes are linear and parallel. Pits of this kind are present in the vessels of many of the Magnoliaceae.

PERFORATIONS

Perforations are openings between cells and may be derived from pits by the dissolution of the closing membranes. Three main types may be distinguished:

(1) Scalariform perforations, in which parallel bars occur, as in the vessels of Magnolia and other primitive forms. Some of the bars may be branched, but not to an extent to destroy the parallel arrangement.

(2) Reticulate perforations, in which the bars are so branched that the parallel effect is destroyed. Perforations of this kind may be formed in the vessels of Panax or Didymopanax.

(3) Simple perforations, or porous perforations of Jeffrey (10, p. 99), in which a single large opening is present, as in the vessels of Dubautia and other specialized angiosperms.

Vessel-segments were found to terminate in three main ways:

(1) A segment may extend and continue the central cavity or lumen beyond the perforation into a tapering tracheid-like end, which may be inserted between adjacent tracheids or vessels or other elements with which intercommunicating pits are formed after the manner of a tracheid-end. Such projections have been described as tracheid-like. (These may be seen in Straussia.)

(2) A solid tonguelike projection may extend beyond the perforation, overlapping the next adjoining segment. Tonguelike projections are apparently derived from tracheid-like projections, and differ from the tracheid-like ends in not possessing a lumen and hence in having lost their physiological function. Such projections have been described as tongue-like.

(3) The segment may terminate abruptly at the plane of perforation, in which the termination is described as truncate.

MONOCOTYLEDONEAE

Order PANDANALES

Family PANDANACEAE

The Pandanaceae are confined to the Tropics of the Old World, especially in the Malay region.

Pandanus tectorius Sol. HALA, PUHALA, LAUHALA, or SCREW PINE. Material, lxv:32:1464.

Pandanus odoratissimus L.

Pandanus is a small littoral or lowland tree 20 feet high, abundant on the windward side of the islands of Hawaii, from sea level to 1,000 feet: distributed from Hawaii to Arabia. The leaves were woven into mats. The wood is hard, fibrous, brittle, light yellow, with dark fibro-vascular bundles. Growth is endogenous. No secondary xylem is formed.

CROSS SECTION

Gross.—The fibro-vascular bundles are broadly crescent-shaped in outline; they become more numerous and composed in large part of sclerenchyma fibers toward the outer part of the stem.

Minute.—Two large vessels, 0.12± mm. in diameter, are found in each bundle. The walls are thin, 0.002± mm., and the lumina open. The schlerenchyma fibers of each bundle are 0.009± mm. in diameter, and exhibit marked concentric layers. Outside the bundles occur large sclerenchyma cells, 0.09± mm. in diameter, and nearly isodiametric, rarely elongated or branched. The ground tissue is composed of the rather thick-walled, finely pitted, nearly isodiametric cells 0.015± mm. in diameter.

LONGITUDINAL SECTION

Gross.—The bundles are dark brown, fibrous, extremely hard and strong. The wood is hard, brittle, and difficult to cut or split.

Minute (maceration).—The vessels are composed of long segments, with scalariform perforations. The sclerenchyma fibers are 2± mm. in length.

Order LILIIFLORAE

Family LILIACEAE

The Liliaceae comprise about 2,450 species of general distribution. Only 5 genera with 8 species occur in Hawaii.

Dracaena aurea Mann. HALAPEPE. Material, vii:2.

This species is endemic to Hawaii and occurs throughout the group in dry situations at elevation of 1,000-2,000 feet. It reaches a height of 35 feet and a D. B. H. of 3 feet. In Dracaena, the growth is at first endogenous. After the stem reaches a certain diameter, usually a fraction of an inch, a cambium is formed and true secondary xylem is produced, composed of slightly thickened wood-parenchyma cells in which bundles of tracheids occur, each bundle of which contains one or two small central strands of phloem nearly enclosed by the tracheids. The secondary vesselless wood thus formed is light yellow in color, soft, of fine even texture, and without heartwood or growth-rings.

CROSS SECTION

Gross.—The tracheid bundles are broadly elliptical in outline with obtuse rounded ends; they are 0.5± mm. in diameter, slightly darker in color than the surrounding tissue, numerous, and evenly distributed.

Minute.—There are no rays or growth rings. The fibro-tracheids are polygonal in outline, 0.06± mm. in diameter, thick walled (0.012± mm.) and with rounded, often circular lumina. Bordered pits are present in all adjacent walls, and half-bordered pits communicate with adjacent parenchyma. The central phloem strand is not invariably completely surrounded by the tracheids. Generally a narrow strand of thin-walled cells joins the enclosed central phloems with the surrounding parenchyma. The parenchyma cells composing the tissue in which the tracheid bundles lie are generally four-sided, thin-walled, 0.002± mm. in thickness, and possess numerous sub circular or elliptical, irregular pits 0.004± mm. in diameter.

LONGITUDINAL SECTION

Gross.—The tangential and radial sections are very similar, the main difference consisting in the fact that the bundles appear slightly wider in the radial section. The wood is soft, easily cut, very fine and even in texture, and has little variation in color. The luster is dull. Under a lens, the parenchyma cells appear in seriation, especially on the radial surface.

Minute.—The tracheids bear circular bordered pits on their lateral walls, 0.012 mm. in diameter. The orifices are lenticular or slitlike, and generally vertical. At the overlapping tracheid ends, many perfect scalariform pits are present. The parenchyma cells are 0.18± mm. in axial length, nearly four-sided, and in horizontal seriation, especially in the radial aspect.

MACERATION

The tracheids are 5± mm. in length, and taper from near the middle to obtuse ends. The walls are thickest in the central portion of the tracheid, and become gradually thinner toward each end. Circular pit markings with slitlike or lenticular orifices prevail in the walls except at the ends where scalariform pits are commonly present. No perforations were found.

DISTINGUISHING CHARACTERISTICS

The secondary wood is without vessels or rays, is whitish-yellow, soft, easily cut, of very fine even texture, and finely mottled on the cross section surface. The tangential and radial surfaces are nearly alike, and fine transverse lines are visible under a lens, especially on the radial surface. The tracheids are thick-walled and arranged in bundles with one or more central strands of phloem.

DICOTYLEDONEAE

Order URTICALES

Family MORACEAE

The Moraceae are mainly trees or shrubs with latex, occurring largely in warm climates. The fig, mulberry, and breadfruit belong to this family. The wood is characterized by vessels of varying diameter, simple perforations, and bordered or simple pits. The rays are several cells broad. The wood-prosenchyma bears simple pits and may be septate.

Artocarpus incisa L. ULU, BREADFRUIT. Material, xl:31:1431.

The genus consists of about 40 species distributed from Ceylon to China. *Artocarpus incisa* is indigenous to the Sunda Islands and was introduced to other Pacific islands by primitive man. It does not produce seed. The tree reaches a height of 60 feet and a D. B. H. of 2 feet. The wood is light, soft, diffuse porous, with a broad zone of yellow sapwood and with a reddish-brown heartwood in large trees; without structural growth-rings; pith large, 0.5+ inch.

CROSS SECTION

Gross.—The pores are visible without lens, mainly isolated, and without tyloses or other contents. The rays are much smaller than the pores, barely visible without lens.

Minute.—The vessels are large, sometimes over 0.3 mm. in diameter, most of them isolated and circular in outline, but some compactly grouped 2-3+ together; the walls are very thin (0.002 mm.). The rays are 1-3+ cells wide, thin-walled, and composed of radially elongated cells; the walls are minutely pitted. The wood-prosenchyma cells are in regular radial rows, are of large diameter, rounded in outline, and thin-walled, with large open lumina. The wood-parenchyma is mainly paratracheal, with lateral extensions from the radial walls of the vessels. The cell walls are thin and the diameter of the cells nearly the same as that of the fibers.

RADIAL SECTION

Gross.—The surface has a silky luster. The rays and vessels are slightly dark colored and visible without a lens.

Minute.—The vessels are composed of short segments. The walls bear rather large, usually semibordered pits, with open lenticular or elliptical outlines. The pits in communication with the ray cells are often very narrowly semibordered and may be nearly simple. The rays are composed mostly of radially elongated cells, but some axially elongated marginal cells are present. The pits communicating with prosenchyma are minute. Some communicating with vessels are rather large, semibordered, or nearly simple. Those communicating between ray cells are intermediate in size, sub-circular in outline, and not distinct. The prosenchyma cells bear indistinct slitlike simple pits, and here and there thin filmlike transverse membranes. The wood-parenchyma cells are long (0.15± mm.) and of large diameter (0.04± mm.).

TANGENTIAL SECTION

Gross.—The vessels are plainly visible without lens, and rather dark colored. The rays are small and visible with lens.

Minute.—The rays are narrowly elliptical in outline, rather obtusely pointed, 1-3 cells wide, and 1-25+ cells high. The cells are rather uniform in size and nearly circular in outline. Axially elongated cells are present in uniseriate rays and are sometimes seen at the margins of the wider rays.

MACERATION

The wood-prosenchyma is composed of thin-walled fibers, mostly cylindrical in the central portion, with long tapering ends. Pits are present in the cylindrical portion, but rather indistinct. The vessel segments are short, with transverse or only slightly oblique ends. The perforations are simple. The pit markings are generally lenticular, but somewhat variable in size and shape.

DISTINGUISHING CHARACTERS

Breadfruit wood is light, soft, of even texture, and without evident growth-rings or heartwood; the sapwood is yellow and the heartwood deep reddish-brown. The vessels are visible without lens, and are without tyloses or other contents, diffuse, mainly isolated; segments short with large simple perforations. The pits are rather large and mainly semibordered, but nearly simple pits occur. The rays are 1-3+ cells wide, visible in cross section with lens, and imperfectly heterogeneous. The fibers are arranged in radial rows, are of large diameter, thin-walled, with large open lumina. The wood-parenchyma is rather abundant, paratracheal, with extensions from the radial sides of the vessels.

Family URTICACEAE

The family comprises 500 species of plants mainly tropical, distributed over both Hemispheres. There are 41 genera, 9 of which occur in Hawaii. Two of these, Neraudia and Touchardia, are endemic. Two genera, Pipturus and Urera, have arborescent species.

Pipturus gaudichaudianus Wedd. MAMAKI OR MAMAKE.

Pipturus albidus G.

Material, cix:63:1482.

Pipturus is a shrub or small tree, in mesophytic habitats, at elevations of 1,500-4,000 feet. This species occurs also in Tahiti. A strong fiber is furnished by the bark, from which the Hawaiians made their tapa cloth. The wood is reddish-brown, soft, with a zone of sapwood in which the color gradually becomes lighter in shade or white. There are no distinct growth-rings.

CROSS SECTION

Gross.—The pores are small, visible with lens, diffuse, isolated or in small groups. The rays are light brown, as a rule, slightly smaller than the vessels, and visible without a lens.

Minute.—The vessels are angular in outline, isolated or grouped 2-6+ together, mostly radially. The size is rather uniform, 0.09± mm. in diameter. The lumina contain tyloses. The walls are very thin, 0.002± mm. The rays are 1-4+ cells wide, and are composed of moderately elongated cells, with numerous rather small pits. The walls are thin. The cell cavities contain globules of resinlike material. The prosenchyma cells are large, 0.04± mm. in diameter, polygonal, thin-walled (0.004± mm.), with large open rounded lumina, and are arranged in radial rows. Pits are fairly abundant in the radial walls. Wood-parenchyma is paratracheal; sparingly developed.

RADIAL SECTION

Gross.—Rays and vessels are visible without lens, but not prominent. The luster is dull; the wood straight-grained, of fine and even texture, and easily cut.

Minute.—The vessels contain tyloses. The walls in mutual contact bear crowded hexagonal pits (0.12± mm. in diameter). The walls in contact with rays bear large elliptical or irregular semibordered or simple pits. The segments are 0.24± mm. in length and bear circular perforations in the end-walls, many of which are of about one-half the diameter of the vessel. The rays are composed partly of cells moderately elongated radially. The marginal row or rows of cells may be greatly elongated axially. The uniseriate rows consist mainly of axially elongated cells. The cell cavities contain globules of resinlike material which partly obscure the numerous rather small pits in the walls. Large elliptical or irregular semibordered or simple pits are formed in contact with vessels. The prosenchyma cells bear numerous short slitlike simple pits in their radial walls; septae are present.

TANGENTIAL SECTION

Gross.—The tangential surface is of fine, even texture. The vessels are visible with lens, but the rays are fine and indistinct even under magnification.

Minute.—The rays are narrowly elliptical, acutely or acuminately pointed, 1-3+ cells wide, and 1-30+ cells high. The cells are mainly subcircular or broadly elliptical in outline, or elongated at the margins and in the uniseriate rays. The prosenchyma cells bear few pits in the tangential walls.

MACERATION

The fibers are short and of large diameter, cylindrical or prismatic in the central portion. The ends taper for about one-third the length of the fiber, and bear few pits. Forked ends are frequent.

DISTINGUISHING CHARACTERS

The wood is dull reddish-brown in color, becoming gradually lighter in shade in the sapwood, is soft, easily cut, of fine, event texture, and without growth-rings. The vessels are small, visible with lens, filled with tyloses, and bear in the end-wall a simple circular perforation often less than one-half the diameter of the vessel. The pits are bordered in the common walls, semibordered or simple in contact with rays. The rays are 1-3 cells wide and 1-30+ cells high, visible without a lens, heterogeneous. Wood-parenchyma is sparingly developed. The fibers are short, of large diameter, thin-walled, and arranged in radial rows.

Order SANTALALES

Family SANTALACEAE

The Santalaceae consist of 250 species of herbs, shrubs, or trees distributed mainly in temperate continental climates or in tropical Polynesian or Australasian islands. Trees of the genus Santalum possess haustoria in connection with their roots by which they may become parasitic upon the roots of other trees. The wood is characterized by even texture, vessels with simple perforations, narrow rays, and fibers with bordered pits.

Santalum freycinetianum Gaud. ILIAHI, SANDALWOOD. Material, c:—:1479.

Sandalwood is a medium-sized tree, reaching on the heights of Mauna Loa a height of 50 feet and a D. B. H. of 2 feet. It is variable, and has a number of distinct varieties. It was formerly common on all the islands of Hawaii, but the forests have been largely destroyed as sandalwood was one of the most valuable of Hawaiian woods. It thrives in dry regions, at elevations of 2,000-5,000 feet. The wood is whitish gray, of firm even texture, and medium hardness.

CROSS SECTION

Gross.—The pores are small, visible with lens, and isolated. The rays are smaller than the pores, visible with lens. Concentric rings are indicated by variation in color.

Minute.—The vessels are subcircular in outline, very uniform in diameter (0.07± mm.), isolated, and thin-walled. The lumina are free from contents.

The rays are 1-2 cells wide, with brown resinlike contents. The prosenchyma cells are small, rather thick-walled, polygonal in outline with rounded lumina, and in no definite arrangement. Large bordered pits are present in all walls. The wood-parenchyma cells are larger than the fibers, diffuse, and contain resinlike globules or crystals of calcium oxalate. Some of the cells are very thick-walled (0.012± mm.); the most are thin-walled.

RADIAL SECTION

Gross.—The surface is a dull, uniform whitish-yellow. Under a lens, beads of reddish resinlike material are visible, and to a less extent in the wood-parenchyma. The wood is cross-grained.

Minute.—The vessels bear circular, vertically arranged, bordered pits, with short lenticular orifices, or semibordered pits in contact with ray-cells. The perforations are simple and of nearly the same diameter as the vessel.

The rays are imperfectly heterogeneous, with radially elongated cells in all but the marginal row, in which the cells are comparatively higher and shorter. The radial walls bear mostly circular semibordered pits. The prosenchyma cells bear conspicuous circular-bordered pits with crossed lenticular orifices, and of the same diameter as the vessel pits. The wood-parenchyma cells are slightly elongated and contain resinlike globules. Other cells are short and contain crystals. Part of the short parenchyma cells are very thick-walled.

TANGENTIAL SECTION

Gross.—The rays are small and indistinct under a lens. The vessels are straight, free from contents.

Minute.—The rays are mainly 2 cells wide and as much as 20 cells high, or more. The fibers bear numerous large circular-bordered pits on the tangential walls.

MACERATION

The prosenchyma consists of rather thick-walled, crooked fibrotracheids of medium length, and small diameter, with circular-bordered pits throughout their length.

DISTINGUISHING CHARACTERS

The wood is dull whitish-yellow, of medium hardness, and cross-grained. The vessels are diffuse, without contents, small, circular, isolated; perforations simple; pits circular, in vertical rows. The rays are mostly 2 cells wide, up to 20 cells high, and imperfectly heterogeneous. The fibrotracheids bear conspicuous bordered pits, are medium thick-walled, and of small diameter. Wood-parenchyma is diffuse. Short, crystal-containing cells are present, and short, very thick-walled strands occur.

Santalum ellipticum Gaud. Material, xcix:x22:1478.

The structure and other characters are the same as the material used for *S. Freycinetianum,* except that the thick-walled, short wood-parenchyma are much less abundant.

Santalum pyrularium A. Gray. ILIAHI, SANDALWOOD. Material, xcviii:42:1476.

This is a tree that attains as much as 40 feet in height, endemic to Kauai. It grows at elevations of 3,000-4,000 feet, in dry leeward (or sometimes wet) situations. The wood is yellowish-brown, rather hard, becoming gradually light yellow in the sapwood. Growth-rings are present.

CROSS SECTION

Gross.—The vessels are small, visible with lens, isolated. The rays are visible with a lens, much smaller than the vessels. A reddish globular substance may be distinguished in the rays and in some of the vessels. The heartwood is impermeable to alcohol; sapwood permeable.

Minute.—The vessels are isolated, nearly circular in outline, nearly uniform in size, 0.06± mm. in diameter, thin-walled, and communicate with the surrounding prosenchyma by medium-sized bordered pits. There are no tyloses, but some of the lumina contain a yellowish or reddish resinlike substance, especially in the heartwood.

The rays are 1-2+ cells wide, thin-walled, and contain a resinlike substance. The pits are minute, and circular or lenticular in outline. The prosenchyma cells are polygonal in outline, rather small, 0.02± mm. in diameter, medium thick-walled (0.004± mm.), and with rounded lumina often filled with resinlike material. Large bordered pits are present in all walls. Wood-parenchyma cells are few, diffuse, thin-walled, and contain resinlike material. Some of them contain large crystals.

RADIAL SECTION

Gross.—The surface has a waxy luster, and is of fine even texture. The rays are visible without lens, reddish in color, but not prominent. Few are more than 0.5 mm. in height. Under a lens, reddish cell contents are visible, and the vessels in the heartwood are visible with their lumina filled with bright reddish resinlike material.

Minute.—Cells, especially in the heartwood, contain a resinlike material in the cell cavities, which is colorless, yellowish, or deep reddish-brown. Many of the cells are in the form of wide or narrow bars. The vessels have large simple perforations, and not numerous circular-bordered pits with crossed lenticular orifices in vertical rows. The cells of the rays are mostly elongated radially, except the marginal cells, which are higher and shorter. The pits, which are small and circular or elliptical, are for the most part obscured by the cell contents. But few crystal-bearing or thick-walled wood-parenchyma cells occur.

TANGENTIAL SECTION

Gross.—The rays are barely visible with a lens. The vessels, with their reddish contents, are visible in good light without lens, appearing as fine striations.

Minute.—The rays are 1-20+ cells high and 1-2+ cells broad. The cells are subcircular in outline, except at the margin, where in many specimens there is a cell elongated and obtusely pointed.

MACERATION

The prosenchyma is composed of thick-walled, usually crooked or bent, fibro-tracheids of medium length, small diameter, and pitted throughout. The vessel-segments are cylindrical and 0.4± mm. in length. The pit markings vary from lenticular to elliptical or circular in outline, and, except for those formed in contact with rays, are arranged in vertical rows.

DISTINGUISHING CHARACTERS

The wood is of medium hardness, color light brown, becoming gradually lighter in shade in the sapwood. Growth-rings are present. The vessels are diffuse, isolated, visible with lens, with resinlike contents, simple perforations and circular-bordered pits in vertical rows. The rays are 1-2 cells wide and 1-20+ cells high, imperfectly heterogeneous. Wood-parenchyma is diffuse, not abundant. The prosenchyma cells are of medium length, small diameter, and pitted throughout. It is distinguished from *S. freycinetianum* by the more abundant resinlike material in the cells, and the imperfect occurrence either of short crystal-parenchyma or of thick-walled wood-parenchyma.

Order CHENOPODIALES

Family AMARANTACEAE

The Amarantaceae include 40 genera with 655 species of general distribution. In Hawaii only five genera are represented, two of which, Charpentiera and Nototrichium, are endemic. The wood is characterized by vessels with simple perforations and prosenchyma with simple pits. Anomaly in the structure of the stem is recorded for many of the genera.

Charpentiera obovata Gaud. PAPAPALA. Material, xiv:75:1420.

The tree grows 15 to 35 feet high, with a maximum diameter of 30 inches. It occurs in both rainy and dry forests, but especially in the dry, at elevations up to 4,000 feet. The wood is soft, fibrous, extremely light, grayish-yellow, with a very narrow zone of light-colored sapwood. The seasoned wood is traversed by numerous fine longitudinal cavities. It is used for torches.

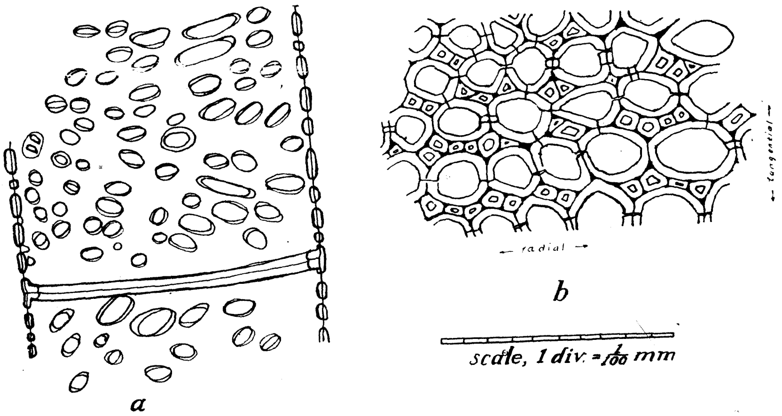

FIGURE 2. Sections of *Charpentiera obovata* wood: **a**, trachea, showing perforation and semibordered pits varying to simple, formed in contact with parenchyma; **b**, cross section, showing arrangement of fibers.

CROSS SECTION

Gross.—The wood is traversed by numerous fine longitudinal cavities, zonately arranged and giving the appearance of growth-rings, though true growth-rings are absent. The rays are whitish, barely visible without lens. The pores are single or grouped compactly 3± together, visible with lens.

Minute.—The vessels are scattered singly or grouped compactly 3± together; where single, subcircular in outline; those in groups, variously compressed or flattened; average diameter, 0.15 mm.; walls very thin, 0.003 mm. thick; cavities without tyloses or other contents. Rays straight, broad as the vessels, composed of short thin-walled cells. Wood prosenchyma (fig. 2, *b*) composed of fibro-tracheids with wide lumina and presenting, by reason of their shape and serried arrangement, a regular pattern of radial rows of large open subcircular cavities alternating with rows of small cavities which correspond to the attenuate unpitted fiber points (fig. 3). The fiber point sections are of twice the number of the large cavities with pitted walls and are crowded between them at the angles or between their radial but not tangential walls. Wood-parenchyma occurs (1) in broad tangential bands; (2) surrounding the vessels and compressed. The cell walls are thin.

FIGURE 3. Drawing, showing macerated fiber of *Charpentiera obovata* wood.

RADIAL SECTION

Gross.—The rays are visible without lens and up to 3 mm. in height; vessels, visible under lens, light-colored.

Minute.—The elements are in serried arrangement. The vessel segments are short, cylindric, 0.24 mm. long, unconstricted, with simple perforations. Pits between vessels are bordered, or simple, or narrowly half-bordered between vessel and parenchyma. The bordered pits are subcircular, elliptical or crowded hexagonal, with large elliptical pit mouths. The simple and semibordered pits are numerous (fig. 2, *a*), large, generally elliptical, but very variable from greatly elongated to subcircular in outline. The wood fibers have numerous pits with oblique lenticular mouths. The rays are composed of nearly isodiametric, thin-walled cells, numerously pitted on all sides in mutual contact, with minute subcircular pits.

TANGENTIAL SECTION

Gross.—The rays are difficult to distinguish, even with lens. The vessels are visible with lens.

Minute.—The rays are 1-5+ cells broad and up to 3 mm. in height, and composed of numerous cells, rather variable in size and shape, but not greatly elongated except where in contact with prosenchyma, where the ray cells appear to merge rather gradually into the prosenchyma. The prosenchyma cells are numerously pitted.

MACERATION

The fibro-tracheids are cylindrical in the central portion and pitted on both radial and tangential sides. The long, attenuate ends are unpitted (fig. 3).

DISTINGUISHING CHARACTERS

The wood is light yellow, extremely light and soft, and traversed, when seasoned, with numerous fine longitudinal cavities in zonal arrangement. The elements are in serried arrangement. The vessels are diffuse, solitary, or grouped 3± together, visible with a lens, with simple perforations, and without tyloses. The rays are as broad as the vessels, homogeneous, up to 2 mm. high and up to 0.15 mm. broad. The cells are irregular in shape and size, but elongated only on the outer surface. The wood prosenchyma is composed of fibro-tracheids pitted in the central portion on all sides, but unpitted over the long attenuate ends. In cross-section they appear in peculiar radial arrangement. The wood-parenchyma is abundant, in broad tangential bands, and also in one or more rows surrounding the vessels.

Nototrichium sandwicense Hbd. KULUI. Material, xiii:76:1419.

The kului is a small tree common on all islands, 15 to 20 feet high, in the lower forest zone in very dry regions at 2,000-3,000 feet. The genus is endemic, comprising three species, of which the other two are shrubs. As with Charpentiera, this genus is allied to

Brazilian genera. The seasoned wood is rather hard, yellowish, fibrous, chambered by small longitudinal cavities in irregular arrangement (fig. 4, *a*).

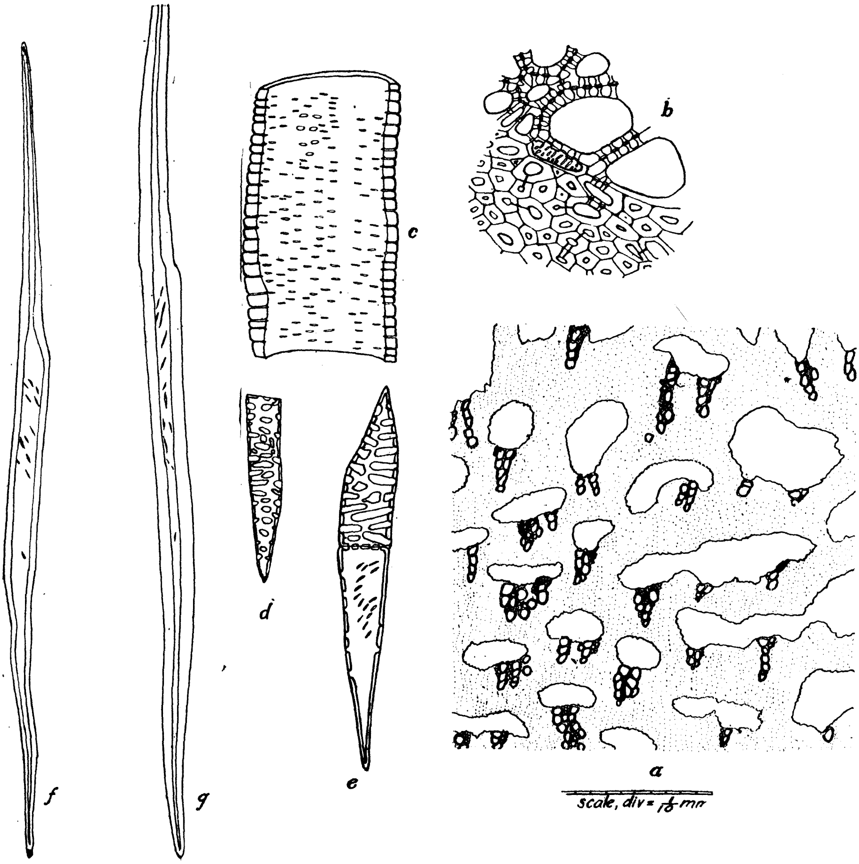

FIGURE 4. Sections of *Nototrichium sandwicense* wood: **a**, cross section, showing chambered cavities; **b**, cross section; **c**, tracheal segment from maceration; **d**, wood-parenchyma cell from maceration; **e**, wood-parenchyma strand from maceration; **f**, and **g**, typical fibers from maceration.

CROSS SECTION

Gross.—No growth-rings present. The cavities are uniform in outline, with vessels, visible under a lens, grouped at one side of the cavity. There are no medullary rays. (Cavities result from disintegration of interxylary phloem?)

Minute.—The vessels are grouped radially in the axial direction at one side of the cavities, 2-10+ together, or rarely isolated, variously compressed on one or more sides, and 0.015-0.09 mm. in diameter, unevenly thick-walled (0.009+ mm.), or rather thin-walled in the smaller vessels; no tyloses or other contents; pit-canals, very broad and widening, both outward toward the pit membrane and inward to form the long slitlike canal mouth; most tracheids, small in diameter and relatively thin-walled. Rays are absent.

Prosenchyma thick-walled (0.009 mm.), irregularly polygonal in outline, and 0.027± mm. in diameter. Wood-parenchyma incompletely vasicentric, limited in amount, very few containing crystals, thin-walled (fig. 4, *b*).

RADIAL SECTION

Gross.—Cavities 0.3± mm. in diameter, numerous, with nearly parallel sides; vessels minute, visible with lens; no rays.

Minute.—The vessel-segments are short, 0.16— mm. long, with numerous lenticular or slitlike pits narrowly bordered. Perforations simple, the plane of perforation as a rule transverse with slight inward projections; tracheids of smaller diameter, numerous.

Wood-parenchyma in single vertical strands of 2-4 cells together; the cells 0.01± mm. in length, pitted with numerous, generally elongated, elliptical pits, irregular in outline (figs. 4, *D*, and *E*). The terminal cell in a strand tapers to a point.

MACERATION

The fibers (figs. 4, *f* and *g*) with elongated, sharply pointed, some forked, unpitted ends, the central portion with numerous lenticular or slitlike pit markings on all sides. Tracheal segments are usually cylindrical (fig. 4, *c*) but often irregular.

DISTINGUISHING CHARACTERS

Wood with collateral secondary bundles distributed irregularly in a mass of thick-walled prosenchyma constituting slightly more than one-half of the volume of the stem. The phloem breaks down, leaving *small longitudinal cavities; no medullary rays* present. The vessels are minute, visible with lens, clustered at side of phloem (or cavities), without tyloses, and with simple perforations.

Family NYCTAGINACEAE

This family comprises about 155 species of herbs, shrubs, or trees in warm climates. In tropical America it is especially well represented. The four-o'clock belongs to this family.

The wood is distinctly different in structure from typical secondary xylem. It is composed of secondary collateral bundles formed from successive zones of cambium which develop in the pericycle. The bundles thus appear in zonal or irregular order, isolated from one another and surrounded by conjunctive tissue, which may either be prosenchymatous, resembling wood-fibers, or parenchymatous. Thin radial strips of cells resembling medullary rays, may also occur. The secondary bundles consist of xylem and phloem. The xylem is characterized by vessels with simple perforations, prosenchyma with simple pits, and parenchyma. In many wood specimens thin-walled parenchyma—in some unlignified—is present with the phloem. In Pisonia, the dry wood specimens are chambered longitudinally by cavities 1± mm. in breadth, resulting from the disintegration of thin-walled perishable tissue.

Pisonia excelsa Blume PAPALA KEPAU.

Pisonia umbellifera (Forst.) Seem.

Material, xliii:1444 B5.

Pisonia is a tree 15 to 30 feet high at elevations of 200-1,600 feet. It is common on the windward wet sides of islands and occurs also in Australia, the Philippines, and Polynesia. The wood is soft and almost herbaceous in character. "Logs of this tree . . . collected for wood specimens, shriveled . . . like stems of banana plants. Trunks a foot in diameter can be felled with one stroke of the axe" (18, p. 145). The dry wood is chambered from the disintegration of the softer tissues to an extent that specimens fall to pieces. The remaining tissue consists of concentric lamellae which readily separate from one another. The wood is yellowish, extremely light, weak, and brittle, and contains a resinlike material which spreads over the surface.

CROSS SECTION

Gross.—The sound woody tissue is in perfect zonal arrangement, the lamellae being about 0.4 mm. in thickness and almost unconnected with each other. The vessels are small, visible with a lens, and either isolated or in contact. Rays are not visible with a lens.

Minute.—The vessels are mainly isolated and circular in outline. In some specimens two or more vessels are in contact and flattened. The diameter is rather uniform (0.09± mm.); the walls, very thin (0.002— mm.). The prosenchyma cells are thin-walled, numerously and finely pitted, polygonal in outline, and in regular radial arrangement. Raylike strands are present, but difficult to distinguish, short celled, as a rule one or two cells wide.

RADIAL SECTION

Gross.—The vessels are visible with lens. Raylike tissue is difficult to distinguish even with lens. The wood of the lamellae is very soft, easy to cut, and with a silky luster.

Minute.—The elements are serried. The vessels are composed of segments of nearly equal length (.02 mm.), with transverse ends. The perforations are simple and large, of nearly the same diameter as the vessel. The pits are 0.009± mm. in diameter, circular, elliptical or linear in outline, mainly semibordered, with transverse lenticular or long slitlike orifices. The lumina often contain a yellow resinlike material. The prosenchyma cells bear very numerous minute circular simple pits. Numerous needllike raphides are present. Raylike bands of cells are present, commonly not more than three cells high, and composed of thin-walled isodiametric parenchyma.

TANGENTIAL SECTION

Gross.—The woody lamellae appear of very uniform texture, under a lens, the vessels being the only distinct structural character visible.

Minute.—The raylike strands are 1-2 cells wide and 1-3+ cells high.

MACERATION

The prosenchyma cells are very short, 0.7+ mm. in length, and of comparatively large diameter (0.09± mm.). The central one-third portion is cylindrical and numerously pitted. The ends taper abruptly into a long and somewhat irregular, or forked, nearly unpitted portion. The walls are thin.

DISTINGUISHING CHARACTERS

The dry wood is composed of thin concentric lamellae, nearly loose from one another, light straw-yellow in color, and with a resinlike varnish which covers the surface, and appears in the vessels and other elements. The elements are serried. The vessels are visible with a lens, mostly isolated, very thin-walled, and with simple perforations. Raylike tissue is present in the form of bands 1-3 cells wide and 1-2 cells thick. Such ray-cells are isodiametric. The prosenchyma is very short, of large diameter, and thin-walled.

Pisonia sandwicensis Hbd. Aulu. Material, xliv:53:1445.

This species is endemic. It reaches a height of 60 feet, a diameter of 2 feet, and grows at elevations of about 2,000 feet in dry situations, in association with *Cryptocarya mannii*, Xylosma, Osmanthus, Rauwolfia, and *Scettonia lanaiensis.* The dry wood is grayish-yellow or blue by decay, with chambered spaces imperfectly zonal in arrangement, so that specimens do not readily separate into thin lamellae. The tissue composing the true xylem is of sufficient hardness nearly to resist impression of the finger nail. The wood is extremely light and brittle, useless for most construction purposes. The surface, on drying, becomes coated with a resinlike varnish.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, and appear mostly grouped radially or slightly tangentially. The rays are plainly visible with a lens. A reddish-yellow resinlike substance occurs in some of the vessels, and in the chambered cavities and other places.

Minute.—The vessels are rather closely grouped, mostly radially, but some extend tangentially, 2-15+ together, very variable in size up to 0.1+ mm. in diameter, with slightly thickened walls, and containing a yellowish resinlike substance, in some cases filling the lumina. The isolated vessels are circular. The grouped vessels are more or less compressed. The prosenchyma-cells are of medium diameter (0.024± mm.), rounded in outline, slightly thick-walled, and with numerous simple pits on all sides and open lumina. The raylike strands are 1-2+ cells wide and the cells usually elongated radially. The walls are thin, numerously and very finely pitted; the cavities often contain a resinlike material.

RADIAL SECTION

Gross.—The narrow chambered spaces alternate with the more durable yellow or grayish xylem strands. Raylike bands are visible without lens, low (0.3± mm.) and, under a lens, many are seen to contain a resinlike substance.

Minute.—The elements are indistinctly serried. The vessels bear circular or elliptical pits with mostly transverse lenticular or long slitlike orifices. The perforations are simple, of the same diameter of the vessel—lumen or smaller. The plane of perforation is transverse or slightly oblique. The ray-cells are mostly somewhat radially elongated, thin-walled, and numerously and finely pitted, or slightly coarsely pitted in contact with the vessels.

TANGENTIAL SECTION

Gross.—The vessels are visible without lens. The raylike strands are small and visible with lens.

Minute.—The ray-strands are 1-15+ cells high and 1-2+ cells wide. The cells are rounded in outline, and rather uniform in size.

MACERATION

The prosenchyma cells are 0.7± mm. in length. They are of irregular and rather crooked shape, but generally cylindrical in the middle one-third portion, where there are numerous small pit-markings. The ends taper—abruptly in most of the cells—into a long only slightly pitted, or forked, end. The pit-markings of the vessel segments are rather small and of rather uniform size.

DISTINGUISHING CHARACTERS

The dry wood is yellowish-straw colored, or blued by fungi; chambered but not readily separating into thin lamellae; slightly hard, but extremely light and brittle. 'A resinlike substance is present in the vessels and other elements. The elements are serried. The vessels are visible in cross section with a lens, as a rule grouped 2-15+ together, variable in size, and with simple perforations. The rays are visible in all planes without lens, 1-15+ cells high and 1-2+ cells wide. The ray-cells are somewhat elongated radially. The prosenchyma cells are of medium length, crooked, cylindrical, and finely pitted in the central portion, and abruptly tapering into a long, slightly pitted point. The parenchyma has probably perished from decay, leaving the cavities.

Pisonia grandis R. Br. PAPALA KEPAU.

Pisonia inermis Forst.

Material, xliii a:68:1443.

This is a small tree 15-18 feet high, of dry habitat. It occurs in association with *Pelea cinerea,* Zanthoxylum, at elevations of 2,000 to 4,000 feet, and occurs rather generally in other Pacific islands. The dry wood is yellow or blackened by fungi, and so chambered that the mass appears composed of coarse and harsh anastomosing fiberlike strands. A resinlike varnish exudes from the tissue and covers the surface. The wood is extremely light and brittle, but holds together, with care. Evidently nearly 50 per cent of the stem is composed of soft tissues which perish on drying, leaving the cavities.

CROSS SECTION

Gross.—The fiberlike sections are 1± mm. in diameter, circular or irregular in outline, irregularly arranged, hard to cut, and brittle. The vessels are visible with a lens, and most isolated. Raylike bands are difficult to distinguish even under a lens.

Minute.—The vessels are 0.08± mm. in diameter, mainly isolated, some adjacent, subcircular in outline, of rather uniform size, slightly thick-walled, with wide pit canals. The lumina of some cells contain a yellow resinlike body. The raylike strands are 1-6+ cells broad, the larger strands largely broken down. The cells are twice the diameter of the prosenchyma cells, nearly isodiametric, thin-walled, and minutely pitted. The prosenchyma cells are rounded polygonal in outline, of medium size, rather thick-walled, irregularly arranged, and with numerous small simple pits in all walls. Wood-parenchyma has largely disintegrated. A few cells are in contact with the vessels.

RADIAL SECTION

Gross.—Under a lens, the elements appear serried. Definite raylike strands are not readily disinguished even under a lens. The fiberlike strands appear to be coarsely anastomose.

Minute.—The vessels are composed of short segments of nearly uniform size and shape. The perforations are large and simple, and the plane of perforation is nearly transverse. The pits are rather uniform in shape and size (0.006 in diameter), mostly subcircular in outline, with transverse lenticular orifices. Such pits are largely of the typical semi-bordered type, and arranged in vertical rows. Raylike tissue is thin-walled and isodiametric; in the dry material the large masses are broken down, leaving longitudinal cavities.

TANGENTIAL SECTION

Gross.—The fiberlike strands anastomose with mostly small meshlike spaces. The raylike strands appear to merge into the wider perishable parenchyma areas.

Minute.—The tangential section shows only a vague appearance of any typical rays.

MACERATION

The prosenchyma cells attain a length of 0.9+ mm. The walls are rather thick, and the cells taper from a cylindrical or prismatic central pitted portion rather gradually into a sharp-pointed, nearly unpitted end. Many variations in size and shape are present.

DISTINGUISHING CHARACTERS

The dry wood is generally yellow, and composed of coarse, harsh, anastomosing, fiberlike strands. A resinlike body is present in the elements, and covers the dry surface. The wood is extremely light and brittle. The elements are serried. The vessels are composed of short segments, uniformly pitted, with moderately thick walls and simple perforations. Typical rays are absent; but small irregular radial strands of parenchyma occur in addition to thicker masses which are largely broken down. The prosenchyma is composed of rather thick-walled, irregular fibers of rather short lengths and medium diameter, and pitted in the central cylindrical portion. A few wood-parenchyma cells are in contact with the vessels.

Order RANALES

Family LAURACEAE

The Lauraceae are a family of aromatic shrubs, lianes, and trees, rarely herbs, composed of 39 genera and 950 species, of general distribution in tropical or subtropical climates. A single arborescent species, *Cryptocarya mannii*, occurs in Hawaii. The leaves are commonly leathery and, with the single exception of sassafras, are entire and evergreen, persisting for several years. The laurel, *Laurus nobilis*, the camphor tree, *Cinnamomum camphora*, the cinnamon tree, *Cinnamomum zeylanicum*, and the American nutmeg, *Cryptocarya moschata*, belong in this family; the true nutmeg, *Myristica fragrans*, is a close relative.

The Lauraceae, with the exception of Cassytha, have a number of uniform characters in the structure of the secondary wood. The vessels are of medium size and of rather uniform diameter throughout the same annual ring. "Sassafras alone is distinguished by the fact that the vessels of the springwood have very wide lumina" (17). Both scalariform and simple perforattions occur. "The number of bars in the scalariform perforations is small, the largest number observed being seventeen (*Cryptocarya wightiana*)". The vessel-pits in contact with the ray show transitions from semi-bordered to simple. Spiral markings occur in Tetranthera and Camphora. The rays are 1-3+ cells wide, and the ray-cells vary in height. Wood-parenchyma may or may not be abundant. Tangential lines of wood-parenchyma occur in Cryptocarya and a few other genera. The wood-prosenchyma may be thin or thick walled, and gelatinous layers occur in some genera. The pits of the wood-prosenchyma are simple and septations occur in sassafras and some other genera.

Cryptocarya mannii Hbd. Holio. Material, xxxiii:37:1440 (38 new).

The genus consists of about 40 species of wide distribution in warmer climates, 10 of which are American. *Cryptocarya mannii* is endemic to Hawaii, occurring in dry habitats, exposed to light, in Kauai and Oahu at elevations of 3,000-4,000 feet. The tree attains a height of 20-40 feet and a D. B. H. of 12 inches. Only a limited use is made of the wood. The wood is rather soft, light yellow in color or with dark streaks, rather straight-grained, fine and even textured; no distinct heartwood.

CROSS SECTION

Gross.—The vessels are barely visible in good light without lens, and mainly isolated. The rays are visible with lens, light-colored, and much smaller than the pores; no distinct growth-rings.

Minute.—Growth-rings are defined by slight compression and thickening of the walls of the prosenchyma, together with the presence of wood-parenchyma.

The vessels are of medium size (0.12± mm.) and fairly uniform throughout the growth-ring. Many are isolated and nearly circular in outline. Others are grouped 2-3, rarely 3-9+, together radially, or in twos tangentially. The walls are thin (0.002 mm.). The lumina are empty except for a few tyloses. The rays are 1-4+ cells wide and consist of elongated cells where more than one cell wide. The cavities are slightly resinous. The walls are numerously pitted with rather small subcircular pits 0.003± mm. in diameter. The prosenchyma consists of moderately thick-walled fibers with simple pits in the radial walls. The outline of the cell is angular; the lumen, fairly large. The walls of the fibers are 0.003± mm. thick. Early-wood cells have thinner walls than late-wood cells. Wood-parenchyma cells are of nearly the same dimensions as the prosenchyma, but the lumina are generally larger. The prosenchyma is distributed irregularly in narrow tangential lines about two cells wide. Paratracheal parenchyma is present, but not abundant.

RADIAL SECTION

Gross.—The rays are seldom over 1 mm. high, color reddish, and visible without lens. The vessels appear as fine brownish lines, and there are dark streaks in many sections.

Minute.—The vessels are composed of short segments with nearly transverse ends. The perforations are simple or scalariform near the primary xylem; the radial walls bear a few large circular perforations and large circular—on some radial walls crowded—bordered pits 0.01 mm. in diameter, with lenticular orifices, or, in contact with wood-parenchyma, very narrowly semi-bordered or even simple pits. In contact with the rays, larger, as a rule elongated, simple, or very narrowly semibordered pits are formed. Scalariform pits occur near the primary xylem.

The rays are heterogeneous and usually less than 1 mm. wide. The marginal cells are 0.04± mm. in radial diameter, and 0.07± mm. in height. The remaining cells are 0.15± mm. long radially and 0.02± mm. in height. The radial walls bear numerous circular pits 0.003± mm. in diameter, or, in contact with vessels, large, generally elongated pits 0.015± mm. in diameter. Prosenchyma cells are nonseptate. The radial walls bear numerous large simple pits with oblique widely lenticular orifices, many of which have rhombic outlines. The wood-prosenchyma cells are elongated, slightly resinous, and numerously pitted.

TANGENTIAL SECTION

Gross.—The vessels are reddish and visible without a lens. The rays are fine and barely visible without lens.

Minute.—The rays are 3± cells wide and generally less than 30 cells high. The marginal cells are commonly more or less elongated and either obtusely or acutely pointed. The remaining cells are rather uniform in size and subcircular or slightly elliptical in outline.

MACERATION

The vessel segments are short, cylindrical, with or without projection at the transverse or slightly oblique end. Pits are of more than one size. Tracheids are frequent.

The prosenchyma consists of libriform fibers 1-1.5± mm. in length. The radial walls bear many simple pits except towards the end, and many numerous long oblique crossed slits in the inner wall, which traverse the entire side.

DISTINGUISHING CHARACTERS

The wood is rather soft, light yellow, of fine texture, diffuse porous, and without distinct heartwood. The vessels are barely visible in cross section without lens, diffuse, either solitary or in small groups. The vessels are without tyloses; the perforations are simple; the walls bear pits of distinctly more than one size. The rays are heterogeneous, 4± cells wide, and commonly less than 30 cells high, with very large generally elongated narrowly semibordered or simple pits in contact with the vessels. The prosenchyma consists of libriform fibers, with simple pits on the radial walls. Long oblique crossed checks occur on many of the inner walls. The wood-parenchyma occurs in narrow tangential bands wide apart; also, in contact with the vessels, but few surrounding them.

Family PITTOSPORACEAE

This family comprises 9 genera, of which 8 are endemic to Australia. The 70 species of the genus Pittosporum are of general distribution in the Tropics of the Old World. The wood is characterized by vessels with simple perforations, bordered or semibordered pits, and some spiral thickenings. The rays are 1-6 cells wide. The wood-parenchyma is sparingly developed. The fibers may possess septae and bordered or simple pits. There is little wood-parenchyma.

Pittosporum glomeratum Hbd. HOAWA. Material, lxvii:57:1469.

This is a small tree which closely resembles *P. glabrum.* It is found at the eastern end of Oahu. The wood is rather hard, of fine even texture, yellowish-white in color, without heartwood or macroscopic growth-rings.

CROSS SECTION

Gross.—The vessels are very small, visible with lens, diffuse, solitary or in small groups of 2-3+. The rays are whitish, barely visible without lens, and as large or larger than the pores.

Minute.—The vessels are subcircular in outline, small (0.05± mm.) in diameter, isolated or in very small groups. The walls are thin (0.003 mm.) and the lumina free from contents.

The rays are 1-3 cells wide and composed of cells not greatly elongated. The walls are thin (0.002 mm.) and bear numerous minute subcircular pits 0.003 mm. in diameter. The wood-parenchyma fibers are rounded, polygonal in outline, and arranged in radial rows. The walls are thick, 0.006± mm. in diameter, and with pits mostly in the radial walls. The lumina are rather small.

The wood-parenchyma is limited to a few cells in contact with the vessels.

RADIAL SECTION

Gross.—The wood is straight-grained. The rays are whitish, mostly less than 0.6 mm. in height, and fairly visible without lens. The surface has a silky luster.

Minute.—The vessels have simple perforations through some end-walls —as a rule somewhat oblique—which project into the vessel cavity, the perforate opening being about one-half the diameter of the vessel. The pits are small, 0.07± mm. in diameter, subcircular, with lenticular orifices. Vessel pits communicating with the rays are of nearly the same diameter as those between vessels.

The uniseriate rays are composed of cells axially elongated; the multiseriate rays, of radially elongated cells, except for axially elongated cells which occur as a rule at the margins. The pits are minute, subcircular or lenticular in outline. The prosenchyma bears narrowly bordered pits with slitlike orifices.

TANGENTIAL SECTION

Gross.—There is little variation in color or structure visible without a lens. Under the lens, the vessels and rays are visible but not prominent.

Minute.—The rays are narrowly lanceolate in outline and acutely pointed, 1-35 cells high, and 1-3+ cells wide. The marginal cells as a rule are axially elongated; and likewise all the cells of the few uniseriate rays. In other cases, the cells are subcircular or slightly angular in outline, and rather uniform in size. The prosenchyma bears but few pits in the tangential walls.

MACERATION

The vessel-segments are rather long, the ends generally somewhat obliquely inclined and with a perforation of about one-half the diameter of the trachea. Lateral perforations occur. A tonguelike projection is generally present from one or both ends. The pit markings are small, with lenticular orifices. Large simple pit markings are absent. The prosenchyma consists of rather thick-walled, straight, libriform fibers, with pit markings extending to near the point.

DISTINGUISHING CHARACTERS

The wood is rather hard, whitish, diffuse porous, without growth-rings or heartwood. The vessels are not visible without lens, isolated or grouped

2-3+ together, and possess simple perforations through somewhat oblique end-walls. The pits are small, bordered or semibordered, and with lenticular orifices. The rays are 1-3+ cells wide, 1-35+ cells high, and imperfectly heterogeneous. The wood-prosenchyma consists of rather thick-walled libriform fibers. The wood-parenchyma is limited to a few cells in contact with the vessels.

Pittosporum hosmeri Rock. AAWA HUA KUKUI.
Material, lxx:72:1466.

This tree is endemic to Hawaii, growing 18-25 feet high, in dry situations, at elevations of 4,000-5,000 feet.

The wood is light yellow in color, rather soft, of fine and even texture, straight-grained, and without true macroscopic growth-rings, although there is a pronounced zonal variation in color.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, diffuse, mostly grouped in radial rows 2-6 together. The rays are light-colored, visible without lens, and larger than the pores.

Minute.—The vessels are mostly grouped 2-6+ together in radial rows, rather variable in size up to 0.09+ mm. in diameter, with lumina free from tyloses, resin, or other contents, and walls of medium thinness (0.003± mm.).

The rays are 1-6+ cells broad, as a rule with radially elongated cells free from resin or other contents, and with numerous, subcircular pits of medium size, 0.004± mm. in diameter. The wood-prosenchyma cells are rounded, polygonal in outline, and irregular in size and arrangement. The walls are of medium thickness, and bear pits on radial and tangential sides. The lumina are large and open. The wood-parenchyma is not abundant, and mostly in contact with vessels.

RADIAL SECTION

Gross.—The rays are light-colored, as a rule less than 0.7 mm. in height and not conspicuous. The vessels are light-colored, visible under a lens.

Minute.—The vessels have simple perforations. The segments are of medium length and constricted abruptly inward at the plane of perforation, which in some segments is more or less oblique. The pits are subcircular, with lenticular orifices; many of those in communication with rays or parenchyma cells are larger and elliptical in outline with narrow half-borders.

The wood-prosenchyma bears bordered pits of medium size with lenticular or slitlike, vertical, or obliquely inclined orifices.

The wood-parenchyma is paratracheal in distribution. The pits are rather large, circular, or elliptical in outline, and 0.006± in diameter. Many of the pits are clustered three or more together. The cells are 0.15± mm. in length.

TANGENTIAL SECTION

Gross.—The structural characters are indistinct without lens. The rays are narrowly elliptical or linear, not conspicuous even under the lens.

Minute.—The rays are linear lanceolate in outline and acutely pointed, 1-6 cells broad and from 1-30 cells high. The cells are nearly elliptical in outline or slightly angular, and as a rule only slightly elongated, except at the margin where an elongated, pointed cell may be present.

The prosenchyma bears but few pits in the tangential walls.

MACERATION

The vessel-segments are of medium length, and many bear an overlapping tip from one or both ends. Most of the end-walls are more or less oblique and bear a single circular perforation of about one-half the inner diameter of the trachea. The pit markings are variable, as a rule, with lenticular, or long narrow slitlike apertures; the ray- or parenchyma-pit markings possess larger, more open irregularly elliptical, apertures.

The fibers are of medium length (1.± mm.), taper from near the middle, and are pitted to near the points. The walls are of medium thickness and the lumina large and open.

DISTINGUISHING CHARACTERS

The wood is light yellow in color, rather soft, of very fine and even texture, without heartwood or well-defined growth-rings. The vessels are without tyloses or other contents and possess simple perforations. The pits are variable, from lenticular to slitlike or elliptical. The rays are 1-6 cells wide and up to 30 cells high, homogeneous or heterogeneous in composition. The wood fibers are of medium length, with large lumina, and fairly distinct bordered pits. The wood-parenchyma is limited to a few cells mostly in contact with the vessels.

Pittosporum kauaiense Hbd. HOAWA. Material, lxviii:49:1469.

This species is endemic to Kauai at elevations of 2,000-4,000 feet and is one of the largest of the genus, reaching a height of 40 feet and D. B. H. of 10 inches. The wood is grayish-yellow streaked with brown, and somewhat hard. It is fine and even textured, without distinct heartwood or growth-rings.

CROSS SECTION

Gross.—The vessels are very small, visible with lens, diffuse and mainly in radial groups of 2-8+. The rays are whitish, and barely visible without a lens.

Minute.—The vessels are mainly in radial groups of 2-8+ and variable in size, but very few more than 0.07 mm. in diameter. The cavities are free from tyloses or other contents, and the walls are rather thin (0.002± mm. in thickness).

The rays are multiseriate, the walls thin and with numerous small, subcircular pits, 0.003± mm. in diameter. The wood-prosenchyma cells are polygonal in outline, irregularly arranged, medium thick-walled (0.004±mm.), and possess large open lumina. Pits are fairly abundant in the radial walls. The wood-parenchyma consists of a few cells in contact with the vessels, or diffuse among the prosenchyma.

RADIAL SECTION

Gross.—Very few rays are more than 0.7 mm. in height, but are plainly visible without lens. The texture is fine and even, but the grain is more or less irregular.

The vessels have simple, circular or elliptical perforations of about one-half the diameter of the vessel, and the end-walls are more or less oblique. The bordered pits communicating with vessels are of fair size (0.007 mm.), subcircular in outline, with transverse lenticular orifices; those communicating with the rays and parenchyma are larger, more open, and narrowly semibordered. The vessel-segments are serried.

The prosenchyma fibers are intercrossed, irregularly curved, and abundantly pitted on the radial walls with circular-bordered pits with lenticular orifices.

TANGENTIAL SECTION

Gross.—The rays and vessels are visible with lens; but not prominent.

Minute.—The rays are 1-10+ cells broad and 1-50+ cells high, elliptical in outline, and acutely pointed. The cells are very variable in size, from 0.009 mm. to 0.03 mm. in diameter, or elongated at the margin of the ray and in the few uniseriate rays. The prosenchyma bears comparatively few pits in the tangential walls.

MACERATION

The vessel-segments are of medium length (0.7± mm.); the end-walls as a rule are oblique and perforated by a circular or elliptical opening of about one-half the diameter of the vessel. A tonguelike projection is usually present at one or both ends. The prosenchyma fibers taper from near the middle and are 1.± mm. in length.

DISTINGUISHING CHARACTERS

The wood is grayish-yellow, streaked with brown, not very hard, without distinct heartwood or growth-rings. The vessels are visible with lens, are without tyloses or other contents, and have simple perforations through oblique end-walls. The rays are imperfectly heterogeneous, 1-10+ cells broad, and 1-50+ cells high; some of the cells are very low. The prosenchyma fibers are of medium length, medium thick-walled, and pitted especially on the radial surface. The wood-parenchyma is sparingly developed and diffuse.

Family LEGUMINOSAE
Sub-Family MIMOSOIDEAE

The Mimosoideae, entirely absent from Europe, are trees or shrubs (erect or climbing) with bipinnate leaves. The sensitive plant (*Mimosa pudica*), Haematoxylon, Copaifera, and Gleditschia belong to this subfamily. An important gum is yielded by *Acacia senegal,* as a result of the disintegration of the parenchyma. The wood is characterized by vessels with simple perforations, bordered or half-bordered pits; tracheids are absent. The medullary rays are narrow, 1-5 cells broad, and composed of low cells which are elongated radially. In some species of Acacia and Inga, the rays are arranged in tierlike order. Mucilage fibers occur. Septations, sometimes associated with starch storage, occur in case of fibers of Acacia and a few other genera. Secretory canals (17) are present in some genera.

Acacia koa Gray. KOA OR KOA KA. Material, iv:40.

Acacia koa is endemic to Hawaii and one of the most valuable of Hawaiian trees, growing to a height of 80+ feet, and a D. B. H. of 6 feet. It grows in the rain forest, but occurs also in dry districts. It occurs throughout the Territory, at elevations from 600 to 5,000 feet, in a wide range of conditions. It grows at low levels, in association with *Pandanus odoratissimus;* or, at higher elevations (in middle forest zone), with *Myoporum sandwicense,* Suttonia, Metrosideros, and *Sophora chrysophylla.* The wood is dark brown, with narrow zones of black or blackish-brown, and light-colored, sometimes yellowish-white, sapwood. It is rather soft, fine and even textured, resinous, and with indistinct growth-rings. The wood is used for cabinet work, particularly for the construction of the ukulele.

CROSS SECTION

Gross.—The vessels are diffuse, single or in small compact groups, barely visible without lens. The rays are very narrow, smaller than the pores, reddish brown, visible under a lens.

Minute.—The vessels are either isolated or grouped compactly 2-5+ together. When isolated, nearly circular in outline, and comparatively uniform in size (0.2± mm. in diameter). Those in groups are greatly compressed and vary greatly in size. The walls are thin, and the cavities free from tyloses, but many are filled with a brownish substance which reacts slightly to resin tests. The rays are 1-2+ cells wide, and resinous. The prosenchyma cells are rounded, polygonal in outline, 0.03± mm. in diameter, and rather irregularly arranged. The walls are thin, 0.004± mm. in thickness, and the lumina large, many filled with blackish-brown resinous matter. Some of the growth-rings are faintly indicated by compressions of the cells. Pits are simple and present in both radial and tangential walls.

RADIAL SECTION

Gross.—The rays are visible without lens, most less than 0.5 mm. in height, and as a rule resinous. The vessels are straight, many resinous.

Minute.—The vessels bear numerous subcircular pits with short, lenticular orifices. The segments are short; the perforations simple; and the plane of perforation as a rule nearly transverse.

The rays are composed of low, greatly elongated cells, 0.2± mm. in length and 0.015± mm. in height. The walls are pitted on all sides with minute, subcircular pits. Many of the cell-cavities are filled with resinous matter. The prosenchyma fibers bear small, oblique, slitlike pits. The wood-parenchyma cells are paratracheal, 0.15± mm. in length, rather irregularly shaped, and usually minutely pitted. Many coarse elliptical pits occur.

TANGENTIAL SECTION

Gross.—The rays are very narrow, and visible only with a lens; many are dark in color.

Minute.—The rays are homogeneous, 1-2, generally 1 cell wide. The cells are comparatively uniform in size and shape, and rounded elliptical in outline.

MACERATION

The vessel-segments bear numerous pit markings uniform in size. The ends are transverse as a rule, and many bear a short projecting overlapping tip. The fibers are of medium length (1.4± mm.) and taper from near the middle. The sides bear small, slitlike, obliquely inclined, pits.

DISTINGUISHING CHARACTERS

The wood is dark brown, resinous, with zones of black, and with white or light-colored sapwood. The vessels are barely visible without lens, isolated or arranged 2-5+ together in compact groups. The perforations are simple; the segments, short; the cavities without tyloses but many filled with resinous material. The rays are homogeneous, 1-2+ cells, generally 1 cell wide, and up to 30+ cells high. The prosenchyma fibers are nonseptate, medium thin-walled, and with large lumina. The wood-parenchyma is paratracheal.

Black koa is distinguished by the broader rays (usually 2 cells wide) and by the great abundance of resinous material in rays, vessels, fibers, and wood-parenchyma. A drop of alcohol, placed on a dry block of ordinary koa cross-surface, immediately penetrates the vessels; on black koa, it remains for several seconds on the surface.

Acacia koaia Hbd. KOAIA or KOA OHA. Material, ii:8:1412.

The koaia is a small tree, 20-25 feet high, on the dry leeward sides of Molokai, Maui, and Hawaii, and is endemic to these islands.

The wood is dull reddish-brown in color with a narrow zone of light-colored sapwood, very hard, fine and even textured, and without macroscopic growth-rings, though an irregular zonal variation of color is present. The wood was formerly used for spears and similar purposes requiring hardness.

CROSS SECTION

Gross.—The vessels are visible with lens, diffuse, isolated, or in small groups. The rays are very fine, yellowish-brown, visible only by lens, much smaller than the pores.

Minute.—Growth-rings are clearly defined by compression of the elements as well as by terminal parenchyma. The vessels are isolated and subcircular in outline or grouped compactly 2-6+ together either in a radial direction or, to some extent, tangentially. The diameter is fairly uniform for the isolated vessel (seldom found over 0.2 mm.); for the grouped vessels, smaller diameters are common. The cavities are filled with resinous material, but tyloses are not present. The walls are thick, 0.009± mm. The rays are 1-3 cells wide and tend to bend around the vessels. The cell-cavities contain a dark globular material and some also contain large crystals of calcium oxalate. The pits are minute and subcircular. The wood-prosenchyma is composed of libriform, thick-walled fibers, with sharply polygonal outlines and small lumina. The pits are small, uncommon, in the radial as well as the tangential walls. The pectin lamella is seldom thickened at the angles. The wood-parenchyma is mainly paratracheal in distribution, but terminal and diffuse cells are present. Crystal-containing cells are frequently seen.

RADIAL SECTION

Gross.—The radial surface has a waxy luster. The rays are not conspicuous. The vessels are visible with a lens and in heartwood are filled with a blackish substance.

Minute.—The vessels, as a rule filled with dark material, bear numerous pits 0.006 mm. in diameter with lenticular orifices. Those communicating with the rays are of the same size as those between vessels. The perforations are simple, and the plane of perforation is generally not greatly inclined. The segments are short, but variable in size and shape. The rays are homogeneous, and composed of low cells radially elongated. The pits are minute, 0.002± mm. in diameter, and subcircular or lenticular in outline.

The wood-parenchyma cells vary from less than 0.06 mm. in length to 0.15+ mm. The shorter cells are in contact with the vessels. Chambered crystal-parenchyma strands are numerous and diffusely distributed. The pits are minute, and circular or lenticular.

TANGENTIAL SECTION

Gross.—The vessels appear under a lens as dark lines, the rays are small and indistinct even under a lens.

Minute.—The rays are very small, 1-3 cells wide and up to 15 cells high. They are somewhat variable in size and shape, but not elongated. The walls are slightly thickened (0.003 mm.) and the cavities filled with brownish globular contents. Large solitary crystals of calcium oxalate occur in some of the cells.

MACERATION

The wood-parenchyma cells in contact with the vessels bear coarse elliptical pit markings; but the pits in the vessel walls are uniformly small, and more or less grouped. The prosenchyma is composed of short libriform fibers 0.9 mm. in length, which taper from near the middle to sharp points. The walls are thick and bear small slitlike pits.

DISTINGUISHING CHARACTERS

The wood is hard and of fine and uniform texture, dark brown in color, with a narrow zone of light-colored sapwood. The vessels are invisible without lens, thick-walled, short segmented, and with simple perforations and pits of uniform size. Contents are dark. The rays are homogeneous, 1-3 cells wide and 1-15 cells high, and minutely pitted.

The prosenchyma fibers are libriform, short, and thick-walled. The wood-parenchyma is mainly paratracheal in distribution, but terminal and diffuse strands occur. Chambered crystal-strands are among the wood fibers and other elements. Microscopic growth-rings are present.

Subfamily CAESALPINIOIDEAE

Trees or shrubs with pinnate or bipinnate leaves, and reduced flowers. The wood is characterized by vessels of varied diameter, with simple perforations. Spirally thickened tracheids and small vessels are present in some genera. The rays are mostly narrow, 1-8 cells broad, and homogeneous. The wood-parenchyma is abundant and much of it in form of tangential bands. Crystal-parenchyma occurs in some genera. The wood-prosenchyma has simple pits, and many mucilaginous layers and septa are present.

Mezoneurum kauaiense (Mann.) Hbd. UHIUHI.

Material, ix:10:1510.

There are 11 species in all belonging to this genus; these are distributed in the Tropics of the Eastern Hemisphere. *Mezoneurum kauaiense* alone is endemic to Hawaii. This tree reaches a height of 30 feet and a D. B. H. of over 12 inches, and occurs on the leeward side of the islands. On the island of Hawaii it is associated with *Erythrina monosperma, Colubrina oppositifolia,* and *Maba sandwicensis.* The wood is extremely hard, fine and even textured, and has a specific gravity greater than 1. The seasoned wood is dark blackish brown with a very narrow zone of white sapwood, and was formerly used for spears and other purposes requiring exceptionally heavy or hard material.

CROSS SECTION

Gross.—Growth-rings are visible without lens. The vessels are diffuse, visible with lens, single or grouped 2-6+ radially. The rays are yellowish, very narrow, visible only by lens.

Minute.—Growth-rings are defined by compressions of the elements. The vessels, when isolated, are subcircular in outline, and rather variable in diameter up to 0.2+ mm. The walls are rather thick (0.009± mm.) and the cavities filled with a gumlike substance. The rays are 1-2 cells wide and the cells filled with gumlike material.

Wood-prosenchyma is composed of very thick-walled fibers with very small lumina. The walls bear pits on all sides. Mucilage-reacting fibers are very common, the interior layers of which stain heavily with haematoxylin.

Wood-parenchyma is paratracheal, with tangential extensions from the tracheae. Crystal-parenchyma cells are present. Some of the wood-parenchyma cell-walls are greatly thickened.

RADIAL SECTION

Gross.—The surface has a high silky luster. The rays and other elements are visible under a lens. The wood is cross-grained.

Minute.—The vessels are composed of short segments with simple perforations and nearly transverse at the plane of perforation. The pits, generally obscured with gumlike material, are as a rule circular or subcircular in outline, small (0.006 mm. in diameter) and with lenticular, commonly transverse, orifices.

The rays are homogeneous. The cells are 0.07± mm. in length and 0.02± in height. The walls are fully 0.003 mm. in thickness, and some are thickened to resemble stone-cells. The pits are minute, subcircular, and rather abundant. Large crystals of calcium oxalate occur in large numbers in the cell cavities. Wood-prosenchyma fibers are somewhat intercrossed; mucilage-reacting fibers are numerous. Wood-parenchyma cells bear minute lenticular pits in the walls, and some cells are thickened to resemble stone-cells. Chambered crystal-strands are numerous.

TANGENTIAL SECTION

Gross.—Structural characters are visible only with a lens.

Minute.—The rays are 1-2 cells wide and up to 15+ cells high; the cells rather uniform in size and rounded in outline. Crystals occur in many of the cavities, and some of the cells are very thick-walled.

MACERATION

The fibers are libriform, somewhat waxy, and taper from near the middle to sharp points. Pits with oblique slitlike orifices are on all walls and are fairly abundant. The inner layers of the mucilage fibers stain deeply and shrink away from the outer layers.

DISTINGUISHING CHARACTERS

The wood has a specific gravity greater than 1, is very hard, and blackish brown with a narrow zone of white sapwood. Growth-rings are present. The vessels are diffuse, visible with a lens, the perforations simple, the cavities filled with gum(?) and are without tyloses. The rays are homogeneous, 1-2 cells wide and up to 45+ cells high, and crystal-bearing cells are present. The fibers are libriform, short, and mucilage fibers are abundant. Wood-parenchyma paratracheal and metatracheal; chambered crystal-strands are present and some cells are thick-wlled and resemble stone-cells.

Subfamily PAPILIONATAE

Herbs, shrubs, or trees with zygomorphic flowers and usually pinnate leaves (trifoliate in Erythrina). The vessels are very variable in diameter (0.03-6 mm.) and arrangement. The perforations are simple and the pits either bordered or semibordered, very few simple. Tracheids are widely distributed in the family, and spiral thickenings may occur. The rays are from 1-3, rarely 30, cells wide, and some are arranged in tierlike seriation. In part of the genera, including Erythrina and Sophora, the rays are composed of cells of similar height; in the remaining genera, the rays are composed of cells of both high and low form. The wood-prosenchyma bears simple pits and may have inner mucilage-reacting layers. *Sophora* and a few other genera possess septate and starch-storing prosenchyma fibers. In many specimens the wood-parenchyma is abundant, mostly in the form of tangential bands, which include the vessels. Chambered crystal-parenchyma is abundant.

Sophora chrysophylla Seem. MAMANI. Material, v:30:1415.

The genus Sophora consists of more than 25 species of trees or shrubs of general distribution in the warm climates. *S. chrysophylla* is the only species in Hawaii and is endemic. It reaches a height of 20-40 feet and a D. B. H. of over 2 feet, and is of common occurrence from sea level to 10,000 feet elevations.

The wood is deep walnut-brown in color with blackish zones. The sapwood is slightly lighter in color and narrow. It is very hard, heavy, fine, and nearly uniform in texture, and fairly straight-grained. It is durable in the ground and is widely used for fence posts.

CROSS SECTION

Gross.—Growth-rings are indistinctly described by lines of wood-parenchyma. Groups of vessels surrounded by wood-parenchyma are visible without lens. The vessels are small, visible only with lens. The rays are of about the same size as the vessels, reddish-brown, and visible with a lens.

Minute.—The vessels are grouped irregularly together, circular in outline, or more or less flattened by contact, fairly uniform in diameter (0.09± mm.), rather thick-walled (0.006± mm.) and filled with a brownish-yellow gumlike body which does not stain with alcannin but is colored by safranin. The small vessels are numerous, and associated with tracheids and wood-parenchyma. The rays are polyseriate and about as wide as the vessels; the cells are rather thick-walled (0.003± mm.), elongated radially, minutely pitted with circular pits 0.002± mm. in diameter, and filled with gum, and some with rhombic crystals.

The wood-prosenchyma is composed of libriform fibers irregular in arrangement, very thick-walled and with very small lumina filled with resin or gumlike matter. Many of the fibers show one or more concentric mucilage-reacting layers.

Wood-parenchyma is abundant, associated with the vessels, and extends in indefinite tangential bands 5± cells wide. The walls are rather thick (0.003± mm.). The cavities are filled with gumlike matter and rhombic mineral crystals are present. The tangential diameter (0.03± mm.) exceeds that of the fibers. The radial diameter is usually only half that of the tangential.

RADIAL SECTION

Gross.—The elements are filled with a gumlike material which is visible under a lens by reflected light and deep garnet-red in color. The rays are low, usually not much more than 1 mm. in height, slightly light-colored and not very distinct without lens. Alternating bands of prosenchyma fibers are visible under lens.

Minute.—The elements are serried. The vessels are minutely pitted. The pit orifices are narrowly lenticular or slitlike; many are elongated beyond the usually indistinct borders, some having a spirallike effect. The segments are short, 0.18± mm., and the plane of perforation nearly transverse. The perforations are simple, circular, and terminal, and some are lateral in position. Many small tracheids occur in the wood-parenchyma zones together with small vessels.

The rays are composed of elongated cells, most of those at or near the margins being somewhat shorter. The walls are slightly thickened (0.003 mm.) and with numerous small circular pits 0.003± mm. in diameter, or varying to lenticular in contact with vessels. The cavities contain a deep-colored gumlike body which is yellowish-brown by transmitted light, and a few large crystals of calcium oxalate. Mycelium is often present even in presence of the gum. The thick-walled libriform fibers are intercrossed, the lumina are filled with deep-staining gum. The wood-parenchyma cells are 0.19± mm. in length and 0.02± mm. in diameter and commonly in storied arrangement. The pits are small and numerous. Chambered crystal-parenchyma containing 8± crystals in a strand are common and mostly in the wood-parenchyma bands.

TANGENTIAL SECTION

Gross.—The irregular alternation of prosenchyma and wood-parenchyma is visible without lens. Under a lens, the cavities of the vessels filled with garnet-red gumlike material are plainly visible; also, the narrow elliptical rays.

Minute.—The rays are narrowly elliptical in outline and acutely pointed at the margins, generally less than 50 cells high, and from 1-7+ cells in breadth. The cells are circular or broadly elliptical in outline and rather uniform in size.

MACERATION

The vessel segments are cylindrical, short, and the plane of perforations transverse or nearly so. The pit markings are small. The pit orifices vary from nearly circular to transverse or oblique, slitlike in outline. The libriform fibers are 1.± mm. in length, and alternate from near the middle, thick-walled, and brittle after maceration. Tracheids 0.2± mm. in length are common.

DISTINGUISHING CHARACTERS

The dry wood is very hard and heavy with a specific gravity greater than 1, deep walnut-brown in color, with a narrow zone of slightly lighter colored sapwood. The elements are filled with deep reddish-brown gumlike material. Wood-parenchyma occurs in tangential lines with the appearance of indistinct growth-rings. The vessels are visible with lens, grouped irregularly together, thick-walled, without tyloses, but filled wtih gum, short segmented, and with simple perforations. The rays are 1-7+ cells broad and up to 50+ cells high, and homogeneous. The prosenchyma is composed of thick-walled libriform fibers with small simple pits. The wood-parenchyma is in broad tangential lines with large and small vessels, and tracheids. Crystal-parenchyma is rather abundant.

Erythrina monosperma Gaud. WILIWILI. Material, xxvi:36:1513.

The 30 species belonging to this genus are distributed widely in the Tropics and subtropics. The single species, *E. monosperma*, is indigenous in the Hawaiian islands. It also occurs in other islands in the Pacific Ocean. The seeds are buoyant, not readily harmed by sea water, and are transported in the ocean currents with seeds of other cosmopolitan beach plants. *Erythrina monosperma* attains a height of 20-30 feet, and a D. B. H. of 4 feet. The tree is deciduous, losing its leaves in late summer or early fall, and grows in the lowlands up to 1,500 feet in association with *Myoporum sandwicense, Reynoldsia sandwicensis,* and *Nototrichium sandwicense*. The wood is the lightest found in the islands, soft, and yellow or bluish-yellow in color. Growth-rings can not be distinguished without microscope. The wood was formerly used for canoes.

CROSS SECTION

Gross.—The vessels are smaller than the rays, visible without lens, isolated, or in small groups. The cavities are without tyloses. Some of the rays are nearly 0.5 mm. broad, and light-colored. The wood is composed largely of pithlike tissue surrounding the vessels, and narrow tangential lines of prosenchyma without vessels. The pores are barely visible without lens.

Minute.—Growth-rings are defined by slight compressions of parenchyma cells. Vessels either isolated and circular in outline or, less commonly, in compact groups of 2-3+. The diameter is rather uniform (0.24± mm.), the walls are very thin (0.002— mm.), and the lumina free from tyloses. The rays are multiseriate, composed mainly of elongated cells; the pits are circular or broadly elliptical in outline, scattered, and very variable in size, and from 0.001 to 0.015+ mm. in diameter. Those of largest diameter are in radial rows and communicate with intercellular spaces. The prosenchyma forms narrow tangential bands 1-7+ cells wide and is seldom if ever found in contact with vessels. The elements are rounded polygonal in outline, variable in size, attaining diameters of 0.03+ mm.; the walls are of medium thickness (0.004± mm.) with simple pits on all sides. The large diameters tend to occur in radial series, in alternation with 3± irregular rows of cells of smaller outline, which are crowded tangentially between the cells of large outline. The wood-parenchyma zones are two to three times as wide as the prosenchyma zones. The cells are hexagonal, very thin-walled (0.001 mm.) and 0.06± mm. in diameter. Several rows of compressed cells define the growth-rings. The paratracheal cells are compressed for a distance of two or more rows from the vessels.

RADIAL SECTION

Gross.—The rays are 1-2 mm. broad, yellow, and conspicuous. Fine parallel bands of prosenchyma alternate with comparatively wide zones of wood-parenchyma. The vessels are reddish-yellow. Under a lens, the elements appear in radial seriation.

Minute.—The vessel segments are short and uniform in length (0.2± mm.) and in seriation with the parenchyma and prosenchyma. The perforations are simple and the plane of perforation is transverse. The sides have medium-sized bordered pits (0.01± mm. in diameter) with lenticular, transverse or oblique orifices. The pits are arranged in imperfect transverse or oblique rows in such a way that frequently several orifices are found tending to fuse in linear series. Most of the rays are less than 2 mm. in height, and composed of thin-walled, radially elongated cells 0.03± mm. high, and 0.15± mm. long. The pits are circular or broadly elliptical in outline and vary from 0.001 mm. to 0.03 mm. in diameter. The prosenchyma cells are in seriation with the other elements. The walls bear numerous long oblique crossed slits, and rather small simple pits. The wood-parenchyma cells are 0.2± mm. in length and 0.03± mm. in diameter. The walls are pitted with small elliptical pits. Chambered crystal-parenchyma occurs near or in the prosenchyma bands, often forming long continuous rows next to the prosenchyma. The crystals are commonly rather perfect tetrahedrons. The paratracheal 1-3+ rows of cells are compressed and commonly one-half or less of the average length.

TANGENTIAL SECTION

Gross.—The rays are dark yellow, irregularly elliptical in outline and acutely pointed, broader than the vessels, and generally less than 2 mm. in height. The vessels are yellow, and slightly darker in color than the rays. Under a lens light-yellow irregular lines of prosenchyma may be distinguished from the rays.

Minute.—The rays are irregularly elliptical in outline, generally less than 2 mm. high and less than 0.45 mm. wide. The cells are rather uniform in size (0.03± mm.) and subcircular in outline. The walls are minutely pitted. Large pits communicate with the intercellular spaces, and many are greatly elongated in the radial direction (0.06+ mm.). The prosenchyma bears numerous rather small, simple or very narrowly bordered pits generally with oblique lenticular orifices. A few long oblique slits are present.

MACERATION

The vessel segments are very short with transverse ends, and pits of nearly uniform size. The prosenchyma fibers attain a length of 2.+ mm., are cylindrical in the central portion, then abruptly attenuate into very long, rather irregular ends.

DISTINGUISHING CHARACTERS

The wood is very light and soft, yellow or bluish in color and with growth-rings visible only by microscope. The elements are serried. The vessels are visible without lens, isolated or in small compact groups, without tyloses, and composed of short segments of uniform length. The perforations are simple and the pits are of uniform size. The rays are homogeneous, broader than the vessels, and generally less than 2 mm. high. The prosenchyma forms narrow bands 5± cells wide. The walls are of medium thickness and pitted on radial as well as tangential sides. The fibers are characterized by a short cylindrical central portion with long abruptly tapering ends.

Order GERANIALES

Family RUTACEAE

The family comprises 900 species of trees, shrubs, or, rarely, herbs of general distribution in tropical or temperate climates. The genus Zanthoxylum, common in the Tropics, is not found in Polynesia except in Hawaii.

The wood is characterized by vessels with simple, or, rarely, scalariform perforations, and bordered, semibordered, or, uncommonly, simple pits. Spiral thickenings occur in certain species. Wood-parenchyma is present and sometimes is found abundantly. Chambered crystal-parenchyma is present in a few genera. The wood-prosenchyma bears simple or narrowly bordered pits. Secretory cavities occur in this family (16).

Zanthoxylum oahuense Hbd. AE or HEAE. Material, xcv:x30:1489 and xciv:58:1483.

A small tree of the rain forest of Oahu, to which it is endemic. Like other Hawaiian Xanthoxyla the stem is without prickles.

The wood is light yellow in color, of fine even texture, rather soft, cross-grained, and without true growth-rings, but with prominent narrow zones of wood-parenchyma.

CROSS SECTION

Gross.—The vessels are small, visible with lens, not numerous, and mostly isolated. The lumina are open, readily permeable to alcohol. The rays are barely visible without lens, of nearly the same diameter as the vessels. Tangential zones of wood-parenchyma are plainly visible without lens.

Minute.—Generally the vessels are not more than 0.14 mm. in diameter, mostly isolated and subcircular in outline, but a few grouped two or more radially or, rarely, tangentially. When grouped tangentially there are lateral perforations in some vessels. The walls are thin and the lumina without contents. The vessels are largely in contact with prosenchyma. The rays are 1-4+ cells wide and composed of radially elongated thin-walled, rather coarsely pitted cells. The wood-prosenchyma cells are irregularly rounded polygonal in outline, rather thin-walled, irregularly arranged, many contain an inner mucilage-reacting layer which stains lightly with either haematoxylin or safranin, and separates from the primary wall upon sectioning. Wood-parenchyma cells are thin-walled, of nearly twice the diameter of the prosenchyma cells, and disposed mainly in straight tangential bands 3± cells wide. Some of the cells are in contact with the vessels.

RADIAL SECTION

Gross.—The rays are low, generally not more than 0.6 mm. high, but plainly visible without a lens. The vertical bands of wood-parenchyma appear as fine striations at right angles to the rays.

Minute.—The vessels are composed of medium short segments with transverse or slightly oblique end-walls. The terminal perforations are simple, circular in outline, and generally smaller than the interior diameter of the vessel. Lateral perforations of nearly the same size and shape occur. For the most part the pits are circular or broadly elliptical in outline, bordered or semibordered, and with lenticular or long slitlike orifices. The rays are homogeneous, thin-walled, and bear subcircular pits rather uniform in size and 0.004± mm. in diameter. Marginal cells in contact with vessels occur in which the ray aperture of the semibordered pit is large and elliptical in outline. The vessel apertures of such pits are either lenticular or slitlike. Each of the wood-prosenchyma cells bears commonly about one vertical row of simple slitlike pits along the radial wall. The wood-parenchyma cells are of large diameter, and 0.12± mm. in length. The pits are rather small and many are closely grouped. No crystal-parenchyma was found.

TANGENTIAL SECTION

Gross.—The rays are barely visible without lens. The wood-parenchyma is prominent, appearing in broad, wavelike lines.

Minute.—The rays are elliptical in outline and obtusely pointed, 1-4+ cells broad and 1-20+ cells high. The cells are rounded polygonal in outline, nearly isodiametric, and rather uniform in size.

MACERATION

The vessel segments are 0.07± mm. in length. The end-walls are transverse or slightly oblique. The terminal perforation is simple, circular in outline, and generally smaller than the lumen of the vessel. Lateral perforations occur. The pit markings are lenticular or slitlike and variously arranged, or, on some surfaces, almost absent. The prosenchyma is composed of crooked fibers of medium length, tapering from near the middle. The pits are small and rather few.

DISTINGUISHING CHARACTERS

The wood is light yellow in color, rather soft, of fine and even texture, cross-grained, and without true growth-rings. The vessels are small, visible with a lens, few, mainly isolated, and largely in contact with fibers. The perforations are simple and smaller than the vessel lumen. The rays are homogeneous, 1-4 cells broad and 1-20 cells high. The fibers are rather thin-walled, commonly contain an inner mucilage-reacting layer, are of medium length and irregularly curved. The pits are few, small, and simple. Wood-parenchyma is composed of cells of nearly twice the diameter of the fibers and mainly disposed in numerous tangential bands 3± cells broad.

Zanthoxylum kauaiense Gray. A'E. Material, xci:x13:1490.

A small tree, 40 feet high, endemic to Hawaii. It occurs on the dry leeward side of Kauai at elevations of 3,600 to 4,000 feet, in association with *"Zanthoxylum dipetalum,* var. *β, Alphitonia excelsa, Cyanea leptostegia, Cryptocarya mannii, Bobea mannii,* and *Tetraplasandra waimeae."* (18, p. 199.)

The wood is whitish, rather hard, straight-grained, or fine even texture, and with growth-rings. A thin amber-colored varnish covers the dry surfaces. Dark colored vertical streaks occur on some of the wood specimens.

CROSS SECTION

Gross.—The vessels are few, small, visible with a lens, diffuse, isolated or in small groups. The lumina are filled with an amber-colored body and the wood is not readily permeable to alcohol. The rays are smaller than the pores, visible with a lens. Growth-rings are defined by zonal variation in color, terminal parenchyma, and, to some extent, by variations in the number of pores. Some cross sections show blackish tangential zones of tissue

Minute.—The vessels occur both isolated and grouped, as a rule radially, 2 to 3+ together, and mainly in contact with prosenchyma. The diameter is somewhat variable, but seldom found more than 0.12 mm. The walls are rather thin (0.003 mm.). The lumina contain a resinlike material which stains with safranin. The rays are 1-2+ cells wide; the cells, thin-walled, with numerous subcircular pits 0.003± mm. in diameter. The prosenchyma cells are polygonal in outline, rather thick-walled, especially in the late-wood, and with rounded lumina. Wood-parenchyma is sparingly developed and mainly terminal. Crystal-cells occur. Some of the tangential areas of abnormal parenchyma are filled with blackish resinlike material.

RADIAL SECTION

Gross.—The rays and vessels are visible without lens and filled with an amber-colored resinlike material, plainly visible with a lens.

Minute.—The vessels are composed of long segments with a single circular perforation of about one-half the diameter of the vessel lumen through each end-wall. The pits are 0.005 mm. in diameter, subcircular in outline, with lenticular or slitlike orifices, and vary little in diameter even when in contact with ray-cells. The rays are homogeneous and composed of radially elongated cells with rather small subcircular pits. In contact with vessels the pits are semibordered, numerous, but not large. The prosenchyma cells bear small simple pits with vertical slitlike orifices in their radial walls. Wood-parenchyma is sparingly developed. Strands of short crystal-containing cells occur in some radial sections.

TANGENTIAL SECTION

Gross.—Rays and vessels are plainly visible with a lens and contain a dark, resinlike material.

Minute.—The rays are narrowly elliptical in outline, obtusely or acutely pointed, and composed mainly of elliptical cells of nearly uniform height.

MACERATION

The vessel segments are rather long (0.4± mm.), with simple perforations smaller than the lumen. The pit markings are small, with lenticular or slitlike orifices and variously arranged, or nearly absent from some surfaces. The prosenchyma is composed of long libriform fibers of relatively small diameter. The walls are more or less thickened and bear a few slitlike pit markings.

DISTINGUISHING CHARACTERS

The wood is rather hard, yellowish-white, straight-grained, diffuse porous. Macroscopic growth-rings are defined by dark-colored zones of thick-walled fibers. The vessels are visible with a lens, isolated, or in small groups. The perforations are simple and smaller than the vessel lumen. The lumina contain a resinlike material rendering the wood impermeable to alcohol. The rays are 1-2 cells wide, 1-12+ cells high, and homogeneous. Wood-parenchyma is sparingly developed. Some crystal-containing strands occur.

Zanthoxylum mauiense Mann. AE or HEAE.

Material, xciii:84:1494.

A small tree, endemic to Hawaii. There are a number of varieties, inhabiting mainly dry locations. Intermediate forms between *Z. mauiense* and *Z. hawaiiense* are mentioned (18, p. 203).

The wood is yellow, non-resinous, rather soft, straight-grained, of fine even texture, and without marked growth-rings.

CROSS SECTION

Cross.—The vessels are visible with a lens, rather numerous, and mainly grouped in radial rows. The lumina are free from contents and readily permeable to alcohol. The rays are visible with lens, and as broad as the vessels.

Minute.—The vessels are mainly grouped in radial rows of 2-20+ together. A few vessels are adjacent tangentially and lateral perforations occur. The outline is mainly subcircular, or slightly compressed, and the diameter usually less than 0.09 mm. The rays are 1-7 cells broad, thin-walled, and numerously and rather coarsely pitted. The prosenchyma cells are irregularly polygonal in outline, the walls moderately thickened, and the lumina rounded and open. Wood-parenchyma is sparingly developed and of nearly the same diameter as the prosenchyma cells.

RADIAL SECTION

Gross.—The rays are visible without lens but not prominent, many more than 1 mm. in height.

Minute.—The vessels are composed of medium long segments with a circular perforation through each end-wall equal to about one-half the diameter of the vessel lumen. There are also circular or elliptical, lateral perforations. The pits are variable from circular in outline to elliptical or even scalariform. The pit apertures vary from lenticular to slitlike. Pits communicating with the rays are semibordered, mainly elliptical, and the orifices lenticular and rather open.

The rays are composed of two types of cells: (1) with a very low radially elongated outline, and (2) with an axially elongated, and radially short outline. The axially elongated cells occur in the uniseriate rays and at the margins of the wider rays. The walls bear numerous, rather coarse subcircular pits. The wood-prosenchyma cells each bear an irregular vertical row or circular-bordered pits with lenticular or long slitlike orifices. Wood-parenchyma cells are of nearly the same diameter as the fibers, but thin-walled and bear coarse subcircular simple pits which are often found grouped 6± together.

TANGENTIAL SECTION

Gross.—The rays, vessels, and other structural variations are visible, but not prominent, with a lens.

Minute.—The rays are linear or narrowly elliptical in outline and acutely pointed. The cells are very variable in size. Those in the central portion of the broad rays are mainly elliptical in outline and vary from 0.006 mm. to 0.03+ mm. in height. Those in the uniseriate rays and mainly at the margins of the broader rays are axially elongated. The prosenchyma bears few pits in the tangential walls.

MACERATION

The vessel segments are long, cylindrical, and bear slitlike or lenticular pit markings which are irregularly distributed but few or none are crowded. The end-walls are generally somewhat oblique, the perforation is circular or broadly elliptical and of about one-half the diameter of the vessel lumen. A tonguelike projection is generally present at each end. The prosenchyma is composed of rather short fibers of small diameter, moderately thickened walls, and long evenly tapering ends. A few tracheids are present.

DISTINGUISHING CHARACTERS

The wood light yellow, nonresinous, rather soft, straight-grained, and without marked growth-rings. The vessels are visible with lens, grouped in radial rows, with simple perforations, without contents and readily permeable to alcohol. The rays are heterogeneous, 1-7+ cells broad, and 1-70+ cells high. The prosenchyma is composed of moderately thick-walled fibers generally less than 0.9 mm. in length, with bordered pits in the radial walls, and a few tracheids. Wood-parenchyma is sparingly developed.

Zanthoxylum dipetalum Mann. KAWAU.

Material, lxxxviii:x16:1491.

Z. dipetalum is a small tree, 30 feet high and distinct in floral characters (18) from other Hawaiian species. It is endemic to Oahu, growing on the leeward slopes of Waiolani.

The wood is light yellow in color, rather soft, of fine even texture, straight-grained, diffuse porous, and with growth-rings defined mainly by the thick-walled, deeper colored, late-wood fibers.

CROSS SECTION

Gross.—The vessels are small, visible with lens, and mainly isolated or in groups of twos. An amber-colored substance is present in small quantity in the vessels, though the wood is slowly permeable to alcohol. The rays are light colored, barely visible without lens. Some tangential areas filled with yellowish resinlike material are formed.

Minute.—The vessels are circular, elliptical, or slightly compressed in outline, thin-walled, and chiefly in contact with prosenchyma. Lateral perforations are common. The rays are 1-2+ cells wide and consist chiefly of radially elongated, and rather coarsely pitted cells. The prosenchyma cells are polygonal in outline, slightly rounded at the angles, medium thick-walled in late-wood. Growth-rings are distinctly indicated by thick-walled late-wood fibers. Wood-parenchyma is sparingly developed. Crystal-parenchyma cells are present.

RADIAL SECTION

Gross.—The rays are low, reddish-yellow in color, and visible without a lens. A yellowish resinlike material is present, but not abundant in the rays and vessels.

Minute.—The vessel segments are long. The perforations are simple circular or elliptical in outline, of about one-half the diameter of the vessel lumen—terminal, many lateral, in position. The pits are subcircular in outline, with short, lenticular orifices, numerous, and uniform in size. The rays are homogeneous, the cells radially elongated, and with numerous small semibordered pits where in contact with vessels. The prosenchyma cells bear circular-bordered pits with lenticular or slitlike orifices. Wood-parenchyma is mainly represented by occasional strands of short crystal-containing cells. Abnormal parenchyma with dark resinlike contents occurs in vertical bands in portions of certain growth-rings.

TANGENTIAL SECTION

Gross.—The rays and vessels are small, visible with lens, are barely distinguishable without.

Minute.—The rays are linear in outline and acutely pointed, 1-2+ cells broad and 1-16+ cells high. The cells are of nearly uniform height, elliptical in outline with an acutely pointed marginal cell at either end. There are few pits in the tangential walls of the prosenchyma.

MACERATION

The fibers are long, comparatively straight, and taper from near the middle. The vessel segments are long, straight, cylindrical, and bear pit markings of uniform size but variously arranged. A tonguelike projection is commonly present at one or both ends.

DISTINGUISHING CHARACTERS

The wood is whitish-yellow in color with darker shaded growth-ring zones, rather soft, of even texture, and straight-grained. The vessels are visible with lens, diffuse, isolated or in small groups. Simple perforations, both terminal and lateral, are present. The lumina contain a small amount of resinlike material, but are permeable to alcohol. The rays are homogeneous, 1-2 cells wide and 1-16 cells high. The fibers are long, straight, and rather thick-walled in the late-wood. Wood-parenchyma is sparingly developed. Strands of short crystal-cells are common.

Zanthoxylum dipetalum Mann. var. β Hbd. Material xc:77:1488.

This variety differs from species in having 3 foliate leaves instead of 5-7 foliate. It is endemic and occurs on one of the leeward slopes of the island of Hawaii.

CROSS SECTION

Gross.—The wood is dull grayish-white, rather soft and brittle. The growth-rings are defined by zones of wood-parenchyma. The vessels are small, visible with lens, and mainly isolated or in groups of twos. The rays are slightly broader than in the species. The vessels and other elements contain comparatively little resinlike material, and the vessels are readily permeable to alcohol.

Minute.—In other points, the wood of the variety is distinguished from that of the species in having relatively thick-walled tracheae, short, thin-walled fibers, and wood-parenchyma in zones 7± cells wide. The rays are 3+ cells wide instead of 2; the ray-cells are shorter and relatively thin-walled.

Zanthoxylum dipetalum Mann., var. γ Hbd.

This variety is endemic to Kauai, occurring on the dry leeward slopes. It reaches a height of 30 feet and a D. B. H. of 1 foot. It occurs at elevations of 3,600-4,000 feet, in association with *Bobea mannii, Elaeocarpus bifidus, Tetraplasandra waimeae,* and other xerophytic species.

The wood resembles that of the species in gross characters, except that it is possibly of a duller luster and harder. Permeability to alcohol is nearly the same. No differences were discovered in the structural characters sufficient to separate the variety from the species; though, in the material examined, the walls of the tracheae and possibly of the fibers were slightly thicker; also, the fibers of the variety were more curved and intercrossed, and more resinlike material was present in the elements.

Pelea sandwicensis Gray. ALANI. Material, xcvii:44:1492.
Melicope

The alani is a small tree endemic to Oahu, growing to a height of 30 feet in the rain forest at elevations of 2,000 to 2,500 feet.

The wood is rather soft, yellowish-white in color, diffuse porous, of fine even texture, without growth-rings, wavy-grained, and tough. It was formerly used by the natives for tapa beaters.

CROSS SECTION

Gross.—The vessels are small, visible with lens, mainly isolated or in twos, without tyloses or other contents (or may contain resinlike contents), and readily permeable to alcohol. The rays are visible with a lens, and somewhat smaller than the vessels. Faint tangential lines of wood-parenchyma are visible with a lens.

Minute.—The vessels, where isolated, are generally elliptical in outline and uniform in size (0.12± mm.). A large number are grouped radially in twos, or rarely three or more. Some of the vessels are adjacent tangentially and lateral perforations are present. Those in groups are somewhat variable in size but only slightly compressed. The rays are straight, 1-4+ cells wide and composed mostly of radially elongated cells, with numerous elliptical pits 0.003 mm. in diameter. The fibers are polygonal in outline, irregular in arrangement, medium thin-walled, and with large open lumina. Numerous, medium-sized, bordered pits are present in radial and tangential walls. Wood-parenchyma cells are of nearly the same diameter as the fibers but thin-walled and distributed in tangential lines, one to several cells wide at irregular but mostly distant intervals. The vessels are mostly in contact with wood-parenchyma.

RADIAL SECTION

Gross.—The wood is wavy-grained; vessels, rays, and bands of wood-parenchyma are visible with a lens, but not prominent. A few vessels contain an amber-colored resinlike substance. The surface has a silky luster.

Minute.—The vessel segments are of irregular length but mostly short and barrel-like in shape. The end-walls are irregularly transverse and oblique; the perforation is circular and generally much smaller than the mean diameter of the vessel lumen. The pits are subcircular in outline with lenticular orifices, either bordered or semibordered, and of nearly uniform size even in contact with ray-cells. The rays are indistinctly heterogeneous, composed mainly of cells with slight radial elongation or nearly square at the margin of the ray. The walls bear numerous subcircular pits of variable diameter up to 0.009 mm. In contact with the vessels, the pits are nearly crowded, and of uniform diameter. The wood-parenchyma cells are 0.12± mm. in length and pitted like the ray-cells. The fibers bear prominent narrowly bordered pits with open slitlike orifices.

TANGENTIAL SECTION

Gross.—The grain is wavy. The rays, parenchyma bands, and vessels are visible with lens but not prominent.

Minute.—The rays are narrowly elliptical or linear in outline, and acute, 1-4+ cells wide, and 1-40+ cells high. The cells are mainly elliptical in outline and of somewhat variable size. The marginal cells show a slight axial elongation. The fibers bear numerous pits on the tangential walls.

MACERATION

The vessel segments are of variable short length, commonly with bulging central portions. The pit markings are of uniform size but variously grouped. The fibers are of medium length and taper irregularly from near the middle.

DISTINGUISHING CHARACTERS

The wood is rather soft, diffuse porous, yellowish-white, and without growth-rings. The vessels are visible with a lens, isolated or in small groups, and composed of short irregular segments with simple perforations. The lumina are mostly empty and readily permeable to alcohol. The rays are heterogeneous, 1-4 cells wide, and 1-40 cells high. Wood-parenchyma occurs in irregular zones and surrounding the vessels. The fibers have slightly thickened walls with narrowly bordered pits.

Melicope cinerea A. Gray, var. δ Hbd. MANENA.

Pelea cinerea (Gray) Hbd.

Material, xcvi:83:1493.

The species is endemic to Hawaii. There are many varieties, mostly of xerophytic habitats. Hillebrand's variety δ is from Hawaii, grows at elevations of 2,000 feet, and is small and shrubby.

The wood is straight-grained, of fine even texture, yellowish-white with black streaks, rather soft, and without very distinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with lens, and mostly grouped 2-8+ radially. The lumina are open and permeable to alcohol. The rays are smaller than the vessels and visible with a lens. Numerous fine broken tangential lines are distinctly visible with lens or barely visible without.

Minute.—The vessels are mostly slightly flattened by radial contact. Tangential groupings and lateral perforations are uncommon. The diameter is fairly constant (0.05± mm.). The vessels are mostly in contact with wood-parenchyma and fibers. The rays are 1-2+ cells wide, the cells not greatly elongated, the walls minutely pitted. Wood-fibers are polygonal in outline, of small diameter, the walls 0.006± mm. in thickness, and the lumina rather small. A few fibers have an inner layer which stains with safranin. Simple or very narrowly bordered pits are present in the radial and tangential walls. Wood-parenchyma cells are of nearly the same diameter as the fibers but thin-walled and are arranged (a) in terminal zones 2± cells wide, and more or less compressed, defining the growth-rings; (b) in numerous irregular tangential lines one or more cells wide; (c) in contact with the vessels.

RADIAL SECTION

Gross.—The rays are low, visible but not prominent without a lens. Fine vertical bands of wood-parenchyma are visible with lens.

Minute.—The vessels have parallel sides, segments 0.7± mm. in length, and simple circular perforations nearly as large as the vessel lumen. The pits are very small, bordered, or, in contact with ray- or wood-parenchyma, semibordered, and are of uniform size with short, lenticular orifices. The rays are composed of cells with slight radial elongation except at the ray-margins and in the few uniseriate rays, in which the cells are generally nearly square or slightly elongated axially. The walls are thin, bearing numerous minute circular pits, and only in contact with vessels are of slightly large outline. The wood-parenchyma zones are numerous and, for the most part, one cell wide, though some zones are two or more cells wide.

TANGENTIAL SECTION

Gross.—The wavy growth-ring lines are visible but not prominent. The rays and wood-parenchyma are visible with lens.

Minute.—The rays are linear or narrowly elliptical in outline, acutely pointed, 1-2+ cells wide and 1-20+ cells high. The cells are mostly elliptical in outline and uniform in size or slightly elongated vertically at the margin or in the uniseriate rays.

MACERATION

The vessel segments are cylindrical, of nearly uniform length and shape, and often with broad projecting tapering ends. The pit markings are small, uniform in size, and with short lenticular or circular orifices. The fibers are 1.3± mm. in length, of small diameter, and taper from near the middle into thin sharp points. The pits are minute and absent near the ends.

DISTINGUISHING CHARACTERS

The wood is yellow, rather soft, and straight-grained. The vessels are small, visible with lens, mainly grouped 2-8+ radially, have large simple perforations and are readily permeable to alcohol. The rays are 1-2 cells wide and 1-20+ cells high. The fibers are rather thick-walled, and bear simple or very narrowly bordered pits. Wood-parenchyma is abundant and occurs in numerous tangential lines, in zones terminating the growth-rings, and in contact with vessels.

Platydesma campanulatum Mann. PILO KEA.

Material, lxxxvii:x16:1484.

The genus is endemic to Hawaii. *P. campanulatum* is a small tree, 20 feet high, on the windward side of Oahu and other islands of the group. The species is the type of the genus, and has a number of varieties the floral characters of which have been described by Hillebrand (9) and Rock (18).

The dry wood is soft, dull whitish-yellow in color, or blued by fungi, and is without macroscopic growth-rings.

CROSS SECTION

Gross.—The vessels are diffuse, small, visible with lens, not numerous, and mainly grouped in small radial rows. The lumina are open and readily permeable to alcohol. The rays are as broad or broader than the vessels.

Minute.—The vessels are grouped 2-5+ radially together or a few isolated. Many vessels are adjacent tangentially, and lateral perforations are present. The diameter is variable but as a rule not more than 0.12 mm. The rays are 1-4+ cells broad and composed of thin-walled cells with numerous minute circular pits. The fibers are medium thin-walled, arranged in regular radial rows, and bear numerous simple pits in the radial walls. Wood-parenchyma cells are of nearly the same diameter as the fibers, but thin-walled, and distributed partly in indistinct narrow tangential lines, and partly around the vessels. Growth-rings are indistinctly indicated by narrow zones of terminal, slightly compressed, wood-parenchyma.

RADIAL SECTION

Gross.—The vessels are composed of segments which are 0.4± mm. in length, and generally constricted near the ends. The end-walls are transverse or, more commonly, slightly oblique. The terminal perforations are circular or elliptical in outline and smaller than the vessel lumen. Lateral circular or elliptical perforations are very common. The pits in the common wall between vessels are bordered and of small diameter with short, open, lenticular orifices. The most common pit or the prevailing type communicating with the adjacent ray- or wood-parenchyma cells is the true annular half-bordered pit (see p. ....), which is more variable in size than other types and is sometimes 0.006+ mm. in diameter. The rays are imperfectly heterogeneous and generally have radially elongated cells except at the margin of the wide rays or in the uniseriate rays where the cells are nearly square in outline or elongated axially. The pits are numerous, subcircular, and from 0.001 to 0.006+ mm. in diameter. The radial walls of the fibers possess numerous simple or narrowly bordered pits with lenticular or slitlike orifices. The wood-parenchyma cells are long (0.2+4 mm.) with small pits 0.003± mm. in diameter.

TANGENTIAL SECTION

Gross.—The surface is of nearly uniform texture. Structural details are not prominent even under a lens.

Minute.—The rays are mostly narrowly elliptical in outline, 1-4 cells wide and 1-40+ cells high. The cells are polygonal in outline and low except in the uniseriate rays or at the ray-margins, where moderately elongated cells occur. The fibers bear few or no pits in the tangential walls.

MACERATION

Many vessel segments terminate beyond the perforation in a tracheid-like end as in Cyathodes (fig. 9, *a*). The pit markings are variable in size, shape, and arrangement. The fibers are rather long, straight, pitted on the radial surface except at the short tapering ends.

DISTINGUISHING CHARACTERS

The wood is soft, dull whitish-yellow in color, and without macroscopic growth-rings. The vessels are small, visible with lens, diffuse, grouped radially 2-5+ together, have simple perforations and open lumina permeable to alcohol. The pits are bordered or annular half-bordered. The rays are 1-4 cells broad and 1-40+ cells high. The fibers have slightly thickened walls with pits in the radial sides. Wood-parenchyma is abundant and in contact with vessels, or in fine broken tangential rows, or in narrow terminal growth-ring zones.

Family EUPHORBIACEAE

This family consists of over 200 genera of wide distribution in the temperate and tropical climates. Five genera occur in Hawaii.

The vessels vary in arrangement and size. Both scalariform and simple perforations occur, and the pits may be either small or large in contact with the rays. The common wall between vessels may bear scalariform-bordered pits. The wood-prosenchyma may be thick- or rather thin-walled and mucilaginous fibers may occur. In species with relatively thin-walled fibers, septae are often found. Wood-parenchyma is sparingly developed.

Aleurites moluccana (L.) Willd. KUKUI OR CANDLENUT.

Material, xxviii:x6:1511.

There are 3 to 5 species belonging to this genus. *Aleurites moluccana* is one of the largest and most common trees in Hawaii, and is thought to have been introduced at an early date by the Hawaiians from the Southern Pacific where it is abundant. Outside of the islands of Hawaii it is widely distributed in the warm portions of the Old World, West Indies, and Brazil. It grows at elevations of 2,200 feet under both wet and dry conditions and reaches a height of 80 feet with a diameter of several feet. The nuts yield an oil which was formerly used for burning in stone lamps or in torches. A dye was extracted from the fruit and used in tattooing.

The wood is whitish or dark from the action of fungi, straight-grained, even textured, and without evident growth-rings.

CROSS SECTION

Gross.—The vessels are without tyloses, scarcely visible without lens, much wider than the rays, diffuse, arranged partly in small radial groups and partly isolated. The rays are fine, visible only with a lens.

Minute.—Growth-rings are indicated by partial compression of the prosenchyma. Part of the vessels are partly isolated and circular in outline, and partly grouped, generally in a radial direction, 2-5+ together, and many four sided. The diameter is rather uniform and 0.15± mm. The walls are thin (0.004 mm.). The rays are uniseriate and curve slightly near vessels. The cells are generally not greatly elongated. The prosenchyma is thin-walled (0.004± mm.), irregularly polygonal in outline, with large lumina. Growth-rings are indicated by zones of tangentially compressed cells. The pits are small with very narrow borders. Wood-parenchyma is rather abundant, paratracheal and metatracheal in distribution. Generally the paratracheal cells are arranged in one row. The metatracheal cells are diffuse.

RADIAL SECTION

Gross.—The vessels are barely visible without lens. The rays are low, visible without lens; the wood is straight-grained.

Minute.—The vessel segments are 0.5± mm. in length, and have simple perforations which are both terminal and lateral in position. The pits are generally large (0.015± mm.) in diameter, semibordered, elliptical or circular in outline, with open lenticular orifices. The rays are thin-walled, and composed of cells most of which are somewhat elongated axially. A few, generally near the middle portion, are somewhat elongated radially. Some of the cells contain single mineral crystals. The walls in contact with parenchyma have numerous, somewhat clustered, subcircular pits of medium size (0.004± mm.), or large, elliptical, semibordered pits (0.15± mm.) where in contact with vessels. The prosenchyma is nonseptate and bears numerous small bordered pits with oblique lenticular orifices exceeding the border. The wood-parenchyma around vessels consists of rather short cells 0.06± mm. in length. The diffuse cells are about twice this length. The pits are 0.004± mm. in diameter and usually clustered. Some cells contain one or more mineral crystals but short crystal-parenchyma is not present

TANGENTIAL SECTION

Gross.—The rays are visible with lens. The vessels may be seen in good light without lens.

Minute.—The common walls between vessels have large circular bordered pits with transverse open lenticular orifices. The rays are uniseriate for the most part and made up of axially elongated cells. Short portions of the rays may be two cells wide, and these are little if at all elongated.

MACERATION

The prosenchyma fibers are of medium length (1.7± mm.) and taper from near the middle. The pit markings are minute, with oblique slitlike orifices. The ends of the vessel segments are transverse or somewhat oblique, and some are provided with a short tonguelike projection.

DISTINGUISHING CHARACTERS

The wood is soft, whitish, diffuse porous, even textured, straight-grained, and without macroscopic growth-rings. The vessels are without tyloses, and have large simple perforations on both terminal and lateral walls. The pits are large, elliptical, and semibordered in contact with parenchyma or of the same size and circular-bordered with lenticular orifices. The rays are 1-2 cells wide, 1-20+ cells high and irregularly homogeneous. The wood-parenchyma is abundant, paratracheal and metatracheal in distribution. A few cells contain one or more crystals. The prosenchyma is rather thin-walled, nonseptate, small pitted, and of medium length, tapering from near the middle.

Euphorbia rockii Forbes. KOKO. Material, xxix:36:1513.

There are more than 600 species belonging to this genus, distributed in warm climates. The species, three of which are arborescent, are endemic to Hawaii. *Euphorbia rockii* is endemic to Oahu, and is typical of the rain forest at elevations of 2,000 feet in association with *Pittosporum glomeratum*, Straussia, and *Pterotropia gymnocarpa*. It reaches a height of 15-20 feet and a D. B. H. of 8 inches. The wood is soft, resinous, whitish-yellow, streaked with brown or blue-black, even textured, without growth-rings, and rather straight-grained.

CROSS SECTION

Gross.—The vessels and rays are visible with lens, diffuse, and mostly in radial groups. The rays are narrow and indistinct even under a lens.

Minute.—The vessels are rather uniform in size (0.09± mm.) and grouped, for the most part, 2-8 radially together. A few are isolated. Many lateral perforations occur in the common radial wall of tangentially adjacent vessels. The vessel cavities are without tyloses; the walls are of medium thickness (0.004± mm.). The rays are uniseriate, and composed of but slightly elongated cells. The walls bear numerous medium-sized pits 0.003± mm. in diameter. The prosenchyma cells are 4-6 sided, irregular in shape and size, and arranged in indistinct radial rows. The walls are of medium thickness, 0.004± mm., and in some specimens contain one or more inner layers which separate when sectioned. The lumina are open and the walls pitted on all sides. Wood-parenchyma consists of a few cells in contact with the vessels.

RADIAL SECTION

Gross.—The rays are fine and indistinct without lens. The vessels are visible with lens as fine straight lines. The wood is light whitish-yellow, streaked with brown or blue-gray.

Minute.—The vessels generally bear coarse, irregular, circular or broadly elliptical, semibordered pits with open, lentciular orifices. The perforations are simple. The rays are composed for the most part of axially elongated cells with numerous medium-sized pits on the upper, lower, and tangential walls. The radial walls bear coarse elliptical or subcircular semibordered pits in contact with the vessels, or small and comparatively few pits where in contact with prosenchyma. The prosenchyma cells bear numerous bordered pits with vertical or oblique lenticular orifices. The wood-parenchyma is sparingly developed and consists of elongated cells in contact with the vessels. No crystals were observed.

TANGENTIAL SECTION

Gross.—The vessels are visible under a lens. The rays are fine and indistinct even under a strong lens.

Minute.—The common walls between vessels bear rather large subcircular bordered pits with long lenticular orifices. The rays are uniseriate, 1-10 cells high, homogeneous, and composed, for the most part, of axially elongated cells. The prosenchyma bears bordered pits.

MACERATION

The vessel segments commonly show lateral perforations. Many of the ends have projecting tips of varying length and form. The prosenchyma is composed of fibro-tracheids 1.± mm. in length, generally with parallel sides and rather short tapering irregular points. Bordered pits occur on all sides except on the tapering ends.

DISTINGUISHING CHARACTERS

The dry wood is soft, resinous, whitish-yellow, streaked with brown, even textured, and without growth-rings. The vessels are visible with lens, wider than the rays, without tyloses, have large bordered or semibordered pits with long lenticular orifices, and are grouped, for the most part, in small radial rows. Perforations are simple and terminal or lateral. The prosenchyma consists of fibro-tracheids of medium length with bordered pits on all sides except at the tapering ends. Wood-parenchyma is sparingly developed and consists of a few elongated cells in contact with the vessels.

Order SAPINDALES

Family ANACARDIACEAE

A family of trees, shrubs, or lianes, of mainly tropical distribution, comprising 58 genera with 420 species. The wood is characterized by narrow medullary rays, 1-4+ cells wide, which may contain resin canals (17). The vessels have simple perforations, except in Campnosperma, Micronychia, and Anaphrenium. Vessels have large bordered pits in contact with vascular elements or large simple or semibordered pits, elliptical in outline, when in contact with ray- or wood-parenchyma. Spiral thickenings occur in the vessels of Pistachia and in *Rhus semialata* var. *sandwicensis*.

The family is represented in Hawaii by *Rhus semialata* Murr., var. *sandwicensis* Engl. The variety differs from the species in having the rachis of the leaf not winged and is peculiar to Hawaii. The species occurs in the Himalaya Mountains.

Rhus semialata Murr., var. **sandwicensis** Engl.

This is a tree 15-25 feet high and less than 1 foot D. B. H., occurring on lowlands at elevations of 600-2,000 feet. Wood is yellowish-gray with hard, dark-colored, resinous streaks, with a dull luster, light, fairly soft, but moderately tough, and contains abundant amber-colored resin, plainly visible, especially with a lens, which comes to the outside and covers the cut surface of dried wood. It is used for plows. By reason of its numerous tyloses it is the slowest of all the species investigated to become water-soaked and sink, and its value for special uses requiring imperviousness approaching that of cork is suggested.

CROSS SECTION

Gross.—The wood is indistinctly ring-porous with large vessels numerous in early-wood, and becoming gradually smaller and fewer in late-wood. They generally occur singly, but may be compactly grouped radially 2-4 or more together. Tyloses are abundant. The medullary rays are scarcely visible without lens.

Minute.—The vessels are isolated and subcircular in outline, or grouped compactly, commonly in radial rows, 2-4 or in late-wood 2-8 together, and tangentially flattened. The lumina are large in early-wood, 0.27 mm. in diameter, and diminish gradually to 0.03 mm. in late-wood; the vessel walls are thin, 0.003 mm. in thickness, and the lumina filled with numerous, tightly crowded tyloses. Tracheids appear with small cavities 0.03± mm. in diameter in outer late-wood, grouped radially and tangentially with small vessels 2-10 or more together.

The rays are resinous, 1-4 cells wide, bending slightly around the vessels; both upright and procumbent cells are elongated in early-wood, shortened in late-wood, and contain crystals. The early-wood fibers have thin walls (0.002 mm.), large lumina, and many contain an inner, separating layer which stains but slightly. The late-wood fibers are tangentially compressed, have thicker (0.004 mm.) walls, and are strongly lignified. The wood-parenchyma is vasicentric and 1-2 cells deep.

RADIAL SECTION

Gross.—The fibers are yellowish-gray with dull luster. The rays appear as fine and blackish lines. The vessels are filled with tyloses and dark-colored material.

Minute.—The vessels bear large bordered pits 0.009 mm. in diameter, rounded or hexagonal in outline, when in contact with vascular elements, or large semi-bordered pits, elliptical in outline and 0.015 mm. in diameter when in contact with parenchyma cells. Tyloses are abundant. Spiral thickenings occur in the smaller vessels. Spirally thickened tracheids 0.03± mm. in diameter are present in late-wood. The rays are heterogeneous, resinous in heartwood, and bear numerous pits in upper, lower, and tangential walls. The radial walls form large, elliptical, semibordered pits in contact with vessels. In contact with prosenchyma the pits are few, minute, and not visible except in favorable sections under high-power magnification. The wood-parenchyma cells are thin-walled, 0.1± mm. long and slightly greater in diameter than the fibers. The pits are commonly large and irregularly elliptical (0.015 mm. in diameter) or, less frequently, minute. The prosenchyma fibers contain both thin and thick transverse resin plates often deep blackish-brown in color. The radial walls bear minute pits which may best be observed in thin, unstained sections mounted in alcohol.

TANGENTIAL SECTION

Gross.—Medullary rays are visible under lens. The light early-wood zones are in marked contrast to the deeper colored late-wood.

Minute.—The medullary rays are 1-4 cells wide and 0.01-0.4+ mm. or 1-30+ cells high. Radial walls of ray cells are minutely pitted except in contact with vessels. The vessel segments are cylindrical, but plane of perforation is generally inclined.

MACERATION

The vessel segments are cylindrical, often project at the ends, and are 0.25-0.75 mm. long with slightly constricted ends. The perforations are simple. The fibers are long, 1± mm. in length, rather evenly tapering toward either end, and not conspicuously pitted. Tracheids with spirals, 0.3± mm. long, 0.03± mm. in diameter, are numerous.

DISTINGUISHING CHARACTERS

The wood is rather soft, grayish-yellow, resinous, and imperfectly ring porous. The vessels are large, have simple perforations, and are filled with tyloses. The rays are 1-4 cells wide and generally less than 0.5 mm. high, heterogeneous, contain crystals, and bear numerous fine simple pits on the upper, lower, and tangential walls, and on radial walls when in contact with vessels. The fibers are minutely pitted, thin-walled, nonseptate, and many resiniferous.

Family AQUIFOLIACEAE

This family of woody plants of mainly temperate distribution, comprises 176 species, belonging, for the most part, to the genus Ilex. Familiar representatives of North America are species of Ilex and Nemopanthus.

The secondary wood is characterized by vessels with scalariform perforations and bordered or semibordered pits. Spirals may occur in the vascular elements and some in the prosenchyma. The fibers have bordered pits. The rays are 1-4 or more cells wide.

Byronia sandwicensis Endl. KAWAU or AIEA.

Ilex sandwicensis (Endl.) Loes

Material, xix:24:1424.

This is a small tree, 20-40 feet high, 12 inches or less D. B. H., and one of the most common trees in the rain forest throughout Hawaii. Associated with it are *Perrottetia sandwicensis, Cheirodendron gaudichaudii,* and *Elaeocarpus bifidus.*

The wood is light grayish-yellow with a narrow zone of slightly lighter colored sapwood, soft, diffuse porous, without growth-rings, and is used for saddletrees.

CROSS SECTION

Gross.—The pores are small, barely visible without lens, occurring singly or irregularly grouped 2-4 together without tyloses. The rays are broad, easily visible without lens, as wide as the largest pores or larger, and light-colored.

Minute.—The vessels are either isolated and nearly circular in outline or grouped 2-4+ together, radially or irregularly, and moderately compressed: the diameter is variable but rarely exceeds 0.16 mm. The vessel walls vary in thickness from 0.015 to 0.006+ mm. The lumina contain a few tyloses. The rays are 1-10+ cells broad, and numerously pitted. The prosenchyma cells are irregular in arrangement and shape, thick-walled (0.009± mm.), with numerous bordered pits. Wood-parenchyma is diffuse, thin-walled (0.002 mm.) and without resin or mineral crystals.

RADIAL SECTION

Gross.—The surface has a slight variation in texture due to the presence of broad rays.

Minute.—The vessels are straight, composed of segments 1.8± mm. in length and bear greatly elongated, elliptical or scalariform, bordered or semibordered pits. The perforations are scalariform and composed of 45± bars. The broad rays are heterogeneous, the cells of the wide portion being greatly elongated radially, and low axially. Cells at the margin or in the uniseriate rays or uniseriate portions of mixed rays are short radially and high axially. The walls are thin and numerously pitted. Such pits are small except where in contact with vessels, where scalariform pits occur. The uniseriate rays are homogeneous. The prosenchyma cells bear numerous bordered pits with slitlike orifices. Wood-parenchyma cells are diffuse, about five times as long as wide, empty or with resinlike contents, and bear numerous small pits, generally with circular or elliptical outlines.

TANGENTIAL SECTION

Gross.—The tangential surface is grayish-yellow and of even texture. Broad rays are visible without lens. Under lens the broad rays are numerous, about twice their width apart, many bluish in color.

Minute.—The vessels curve around the broad rays, and bear mostly scalariform pits. The rays are of three types: (1) uniseriate, (2) uniseriate in part, and (3) multiseriate. Cells in the uniseriate rays or the uniseriate part of the mixed rays are axially elongated. Those in the multiseriate rays or the multiseriate portion of the mixed rays are predominantly low and subcircular in outline. The rays are 1-10+ cells broad and up to 4.3+ mm. in height. The prosenchyma cells have vertically inclined slitlike bordered pits and are nonseptate.

MACERATION

The elements are free from spiral markings. The vessel segments are cylndrical, very long (1.8+ mm.), and terminate in oblique ends. Pit markings are usually scalariform, but elliptical or subcircular outlines with lenticular or slitlike orifices occur. The prosenchyma fibers are very long, sometimes 2.85 mm. in length, 0.05 mm. in diameter, thick-walled (0.009± mm.), attenuate from about one-fourth their length, bear numerous broadly bordered slitlike pits, and have no spirals such as found in *Ilex opaca.* The tracheids are 1.62± mm. long with irregularly pointed ends, thick walls (0.009± mm.) and are pitted with scalariform, elliptical, or circular pits, the latter with narrowly lenticular orifices.

DISTINGUISHING CHARACTERS

The wood is light-colored, rather soft, diffuse porous and without growth-rings. The elements are without the spiral thickenings prevalent in the genus Ilex. The vessels are barely visible without lens, thin-walled, without tyloses, with scalariform pits and scalariform perforations. The rays are uniseriate, uniseriate in part, or multiseriate, and 1-10 cells broad and up to 4+ mm. high. The ray-cells are finely pitted, except in contact with vessels, where scalariform pits occur. The prosenchyma fibers are long and bear bordered pits. Wood-parenchyma is fairly abundant and diffuse in distribution.

Family CELASTRACEAE

The Celastraceae are a family of trees, shrubs, and woody climbers of wide distribution. The climbing bitter sweet, *Celastrus scandens,* is a common American representative of this family.

The wood, as far as investigated (17), is characterized by vessels varying between 0.027 and 0.75 mm. Perforations are usually simple, but scalariform perforations also occur, either exclusively or along with simple perforations. The rays are of varied breadth, from 1-6 cells. The pits are bordered, and spiral thickenings occur in *Euonymus europaeus* L. The wood-prosenchyma generally has bordered pits, but simple pits occur; the lumina are wide. Wood-parenchyma is generally paratracheal.

Perrottetia sandwicensis A. Gray. OLOMEA.

Material, xxi:x9:1410.

A shrub or tree 10-18+ feet in height. Common in the northeastern part of Maui, forming forests of nearly pure growth at elevations of 6,000± feet. It is common in the rain forests of all the islands of Hawaii but is sometimes found in the dry forest.

The wood is yellow brown in color, fairly soft, straight-grained, and without growth-rings. The wood was used to produce fire by friction. Two sticks were used: the upper, Perrottetia; the lower, *Hibiscus tiliaceus.*

CROSS SECTION

Gross.—The rays and especially the vessels are not visible without lens. The surface shows no variation in color or structure to the naked eye. Under lens the rays are numerous and narrow, have a reddish color but do not differ greatly in color from the fibers. The pores are minute, less in diameter than the width of the widest rays, very numerous, and diffuse.

Minute.—Vessels are rounded polygonal in outline, numerous, forming approximately half of the volume of the wood, generally single, occasionally grouped 2-6+ together, without tyloses, or other contents, small (0.066 mm.) in diameter, of nearly uniform size, and thin-walled (0.003 mm.). The rays are 1-6 cells wide. The cells contain resin, and are numerously pitted with small lenticular pits of uniform size, arranged in radial rows. The prosenchyma fibers are polygonal in outline, with wide lumina, and walls of medium thickness (0.003 mm.) with numerous bordered pits in the radial walls. The wood-parenchyma cells are very few and in contact with the vessels.

RADIAL SECTION

Gross.—Rays plainly visible without lens, reddish in color, and about 2 mm. in extreme height. The pores, under a lens, are small, straight, and very numerous, forming a large portion of the mass of woody tissue. The wood is straight-grained.

Minute.—The vessels have nearly parallel sides and have scalariform semibordered pits in contact with the ray-cells. The segments are long (1.3± mm.), rather uniform in length, and have oblique end-walls with scalariform perforations composed of numerous fine bars (45+). The rays are composed partly of tubular cells 0.03± mm. high and somewhat elongated radially, and partly of cells 0.03± mm. radial diameter and elongated axially. The cavities contain a resinlike material. The radial walls in contact with prosenchyma have few small semibordered pits. The walls adjacent to vessels bear rows of elliptical or subcircular pits opposite each scalariform pit-cavity of the vessel. The prosenchyma fibers contain numerous resin plates resembling septae. The bordered pits are numerous, scattered, and have obliquely crossed, lenticular orifices.

TANGENTIAL SECTION

Gross.—To the naked eye there are no visible differences of color or structure. Under a lens, the vessels are minute, numerous, and straight; the rays are faint, reddish, narrowly linear in outline, and acutely pointed.

Minute.—Vessels are characterized by scalariform, elliptical, and circular-bordered or semibordered pits with lenticular and usually transverse orifices. The rays are highly resiniferous, 1-6 cells wide, and 1-45+ cells high. The cells vary from 0.03 to 0.09+ mm. in height, the higher cells occurring generally in the uniseriate marginal portions. The broad rays are irregularly heterogeneous.

MACERATION

The fibers are septate, numerously pitted on the radial walls except the short, irregular, tapering points, which are unpitted. The vessels are separated with difficulty from the fibers.

DISTINGUISHING CHARACTERS

The wood is yellow-brown, fairly soft, and without growth-rings. The vessels are diffuse, generally single, uniform in size, very small, numerous, without tyloses, and pitted with scalariform, elliptical or circular-bordered pits. The perforations are scalariform and composed of numerous fine bars. The rays are irregularly heterogeneous, 1-6 seriate and 1-45+ cells high. The cells contain resin, and are generally pitted with rows of elliptical pit cavities communicating with the adjacent scalariform pit-cavity of the vessel. The fibers are septate, contain resin-like plates, and have numerous bordered pits on the radial walls, except for the short attenuate points. Wood-parenchyma cells are few, occur in contact with vessels, and contain resin.

Family SAPINDACEAE

This family comprises 1,000 species of mainly tropical distribution. In Hawaii four genera occur.

The wood, according to Solereder, is in some species characterized by vessels with simple perforations or scalariform perforations near the primary xylem. Spiral thickenings are found in some genera. The pits are either bordered or semibordered. The wood-prosenchyma bears simple pits. The rays are 1-4 cells broad. Wood-parenchyma is not abundant.

Sapindus saponaria L. A'E, SOAPBERRY.

Sapindus thurstonii Rock

Material, ciii:80:1486.

The name *S. thurstonii* was applied to the Hawaiian form by Rock, who, on further consideration, concluded that the Hawaiian form is not specifically different from the American, *S. saponaria.* The Hawaiian a'e reaches a height of 80 feet and a diameter of 6 feet and grows at elevations of 4,000 feet. The wood is grayish-white streaked with black, soft, diffuse porous, without growth-rings, and straight-grained.

CROSS SECTION

Gross.—The vessels are barely visible without lens, mainly isolated, elliptical in outline, and surrounded by wood-parenchyma, which extends in wavy tangential lines as wide or wider than the vessels. The lumina are mostly open and readily permeable to alcohol. The rays are barely visible without lens and much smaller than the vessels.

Minute.—Some of the vessels are grouped compactly two or more radially or, rarely, tangentially. The diameter is variable, but rarely exceeds

0.25 mm. Some of the lumina contain a resinlike or gummy material which stains deeply with safranin. The rays are 1-4 cells wide, and bend around the vessels. The cells are greatly elongated, and the walls finely pitted. The fibers are rounded polygonal in outline, with moderately thickened walls, and are irregularly arranged. Simple pits are present in radial and tangential walls. The wood-parenchyma cells are of somewhat larger diameter than the fibers, thin-walled, surround the vessels, and form numerous tangential wavy zones 10± cells wide. The rays widen in the parenchyma zones.

RADIAL SECTION

Gross.—A few of the vessels contain an amber-colored material and appear as yellow streaks. The rays are low and not prominent. Alternating bands of wood-parenchyma are visible with lens.

Minute.—The vessel segments are short; the pits are numerous, semi-bordered or bordered, and have lenticular or slitlike orifices; the perforations are simple and as large as the vessel lumina. The prolonged parallel pit orifices produce a spirallike effect. The rays are homogeneous; the cells low, greatly elongated radially, and finely pitted. The prosenchyma bears small simple pits in the radial walls. Wood-parenchyma cells are 0.15± mm. in length, of slightly larger diameter than the fibers, and with circular or elliptical pits 0.003± mm. in diameter. A few strands of short crystal-parenchyma are present.

TANGENTIAL SECTION

Gross.—Faint wavy zones of wood-parenchyma and a few vessels with yellow contents are visible without lens.

Minute.—The rays are elliptical in outline, with acute ends, mainly 3 or 4 cells wide, and up to 35+ cells high; the cells circular in outline, uniform in size with moderately thin walls.

MACERATION

The vessel segments are of variable short length, the pit markings slit-like, the perforations simple and as large as the vessel lumen, and the ends commonly without projections. The fibers are 1.5± mm. long, pitted in the central portion, and taper gradually into long, delicate, very sharp, unpitted ends.

DISTINGUISHING CHARACTERS

The wood is grayish-white, soft, diffuse porous, without growth-rings, and straight-grained. The vessels are visible without lens, and mainly isolated. The perforations are simple, and the lumina generally without contents and readily permeable to alcohol. The rays are homogeneous, 1-4 cells wide and up to 35+ cells high. Wood-parenchyma is abundant and present in numerous tangential bands, visible, in cross section, without lens. Crystal-parenchyma is present. The fibers are medium thick-walled and provided with simple pits.

Dodonaea viscosa L. Aalii. Material, civ:x25:1480.

Dodonaea is largely an Australian genus. *D. viscosa* is a cosmopolitan species of wide distribution in the Tropics, and occurs in Hawaii at elevations from 1,000 to 4,000 feet. It is a small gregarious tree, reaching a height of 25 feet and a D. B. H. of 10 inches.

The dry wood is diffuse porous, reddish-brown in color (black heartwood), very hard, cross-grained, and without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are visible with lens, isolated or in small groups. The rays are smaller than the pores, visible with lens. Fine irregular tangential lines of wood-parenchyma are barely visible without lens. The wood is not readily permeable to alcohol.

Minute.—The vessels are circular when isolated or compressed by contact, and variable in size but not commonly larger than 0.1 mm. in diameter. The walls are medium thin. The rays are 1-2+ wide and filled with a resinlike material. The fibers are polygonal in outline, very thick-walled, and have very small lumina. Wood-parenchyma cells are of nearly the same diameter as the fibers, but thin-walled, mostly filled with resinlike material, and surround the vessels or occur in irregular tangential lines from 1-15+ cells in breadth.

RADIAL SECTION

Gross.—Rays and bands of wood-parenchyma are visible with lens and contain a reddish resinlike material.

Minute.—The vessels have small bordered or semibordered pits of uniform size with lenticular orifices. The perforations are simple and of nearly the same diameter as the lumen. The rays are homogeneous, and composed of radially elongated cells filled with resinlike material. Wood-parenchyma cells are 0.09± mm. in length when in contact with vessels, or 0.2± mm. in the metatracheal bands. Short crystal-parenchyma cells in strands are many.

TANGENTIAL SECTION

Gross.—The rays, wood-parenchyma, bands, and vessels are visible with lens.

Minute.—The rays are elliptical in outline, acutely or obtusely pointed, 1-2+ cells broad, and 1-20+ cells high. The cells are mostly rounded polygonal in outline, of rather uniform size, and filled with resinlike material.

MACERATION

The vessel segments are 0.36± mm. in length, and bear numerous lenticular pit markings of uniform size. Commonly a very short, tonguelike tip projects from one or both ends. The fibers are 0.9± mm. in length, very thick-walled, and taper gradually to sharp ends.

DISTINGUISHING CHARACTERS

The wood is diffuse porous, reddish-brown in color, with a black heartwood, very hard, and without distinct growth-rings. The vessels are small, visible with lens, isolated or in small compact groups. The perforations are simple. The wood is very slowly permeable to alcohol. The rays are homogeneous, 1-2+ cells broad, 1-20+ cells high, and filled with a resinlike material. Wood-parenchyma, filled with resinlike material, occurs in tangential bands, and a few strands of short crystal-parenchyma cells occur. The fibers are very thick-walled.

Order RHAMNALES

Family RHAMNACEAE

The Rhamnaceae are trees, shrubs, or climbers of general distribution. The wood is characterized by vessels with simple or rarely scalariform perforations and less commonly by spiral thickenings. The pits are bordered or semibordered. Wood-parenchyma is not abundant; the wood-prosenchyma bear simple pits.

Colubrina oppositifolia Brongn. KAUILA. Material, lxxii:5:1471

This species reaches a height of 35 feet, a D. B. H. of 12 inches, and is endemic to Hawaii. It occurs on the arid leeward side of the island of Hawaii at elevations of 2,000 feet in association with *Mezoneurum Kauaiense, Myoporum sandwicense,* and other xerophytic species.

The wood is deep reddish-brown in color streaked with black with narrow zone of light-colored sapwood, very hard and with a specific gravity greater than 1. Faint growth-rings are present. The wood is the most difficult of all Hawaiian woods to section. Material treated six months in strong hydrofluoric acid could not be evenly cut in thin transverse sections of large size.

CROSS SECTION

Gross.—The vessels are visible with lens, diffuse, isolated or in small groups. The lumina, in heartwood, contain a light garnet-colored substance by reason of which the wood is not permeable to alcohol. The rays are much smaller than the vessels, visible with lens.

Minute.—The vessels are variable in diameter but rarely exceed 0.12 mm., elliptical in outline when isolated, or moderately compressed by contact in mostly radial groups of 2-3 or rarely up to 8. The rays are 1-2 cells broad; the walls, thin; the pits, minute and obscured by resinlike contents. The fibers are of small diameter, polygonal in outline, very thick-walled, and in regular radial arrangement. Wood-parenchyma cells are of slightly larger diameter than the fibers, and are in contact with vessels, or diffuse, or in indistinct growth-ring zones in which compressed cells occur. Cells containing solitary crystals are frequent.

RADIAL SECTION

Gross.—Resinlike material is rather abundant. The rays are small but visible without lens.

Minute.—The rays are composed mainly of radially elongated cells, but square or axially elongated cells occur at the margin and frequently also in other portions of the rays. The cell cavities contain a resinlike material and crystals are often observed. The walls are mostly thin but some very thick-walled cells occur. The vessels have simple perforations and pits 0.006± mm. in diameter, of rather uniform size and bordered or semi-bordered pits with lenticular orifices. Wood-parenchyma cells are 0.15± mm. in length. Strands of short crystal-parenchyma are numerous.

TANGENTIAL SECTION

Gross.—The structural characters are visible with lens. The vessels contain globules of reddish material.

Minute.—The rays are 1-2 cells wide and 1-23+ cells high. The biseriate cells are low, elliptical in outline, and of nearly uniform size. The uniseriate cells are axially elongated.

MACERATION

The vessel segments are 0.4± mm. in length, cylindrical, and have a large simple perforation at the end. Projecting tips or ends are not common. The fibers are mostly less than 1 mm. in length, and have long, tapering, sharp ends.

DISTINGUISHING CHARACTERS

The wood is reddish-brown with a narrow zone of yellow sapwood, very hard and heavy, and with faint growth-rings. The vessels are diffuse, isolated, or in small radial rows, visible with lens, with simple perforations and not permeable to alcohol in the heartwood zone. The rays are 1-2 cells wide, 1-23+ cells high, and heterogeneous. The fibers are thick-walled and arranged in radial rows. Wood-parenchyma is fairly abundant and strands of crystal-parenchyma are many.

Alphitonia excelsa Reiss. KAUILA. Material, lxxi:6:1472 (35 new list).

The kauila is an indigenous tree, growing on the arid leeward side of the islands at elevations of 2,600-3,000 feet. It reaches a height of 80 feet and a D. B. H. of 2 feet. The species occurs also in Australia, Borneo, and Polynesia.

The wood is cherry-red in color with wide (2-3 in.) light yellowish-brown sapwood, hard, and with distinct growth-rings defined by alternating light-colored zones. It was formerly used for spears.

CROSS SECTION

Gross.—The vessels are diffuse, mainly in small radial rows, and visible with lens. The lumina are open and permeable to alcohol. The rays are much smaller than the vessels, and visible with a lens. Growth-rings are defined by dark zones of hard late-wood, alternating with light-colored zones of mucilage fibers.

Minute.—The vessels are mainly arranged in radial rows of 2-5+ together. A few vessels are adjacent tangentially and lateral perforations are present. The diameter is rather uniform, rarely exceeds 0.14 mm. The rays are 1-2+ cells wide, the walls thin, and with minute pits obscured by resinlike material. The fibers are thick-walled and lignified in growth-ring zones which alternate with zones of fibers with a thin outer lignified wall and an interior separating layer which stains only slightly with the hematoxylin-safranin stain, and reacts, to some extent, to mucilage tests. The transition from one zone to the other is gradual. Wood-parenchyma is sparingly developed and mostly in contact with vessels. No crystal-cells were found.

RADIAL SECTION

Gross.—The rays are fine but visible by reason of their reddish contents. The lumina of the vessels are mostly without contents. Alternating growth-ring layers of light-colored mucilage fibers are prominent.

Minute.—The pits of the vessels are bordered or semibordered, circular in outline, with short lenticular orifices and uniform in size. The perforations are simple and nearly as large as the vessel lumen. The rays are composed mainly of radially elongated cells, but square or axially elongated cells are present at the margins and sometimes at other parts of the rays.

TANGENTIAL SECTION

Gross.—The growth-ring zones are prominent and are defined by alternating zones of light-colored mucilage fibers and dark-colored, thick-walled, lignified late-wood fibers.

Minute.—The rays are 1-2 cells wide and 1-40+ cells high. Most of the cells are elliptical in outline, low, and of uniform size. Marginal cells and a few others are slightly elongated.

MACERATION

The fibers are commonly less than 1 mm. in length, with small, oblique, slitlike pit markings, and taper gradually to long, sharp, unpitted points.

The mucilage fibers are easily distinguished from the thick-walled lignified fibers by their inner separating layer.

DISTINGUISHING CHARACTERS

The wood is diffuse porous, light yellowish-brown in color, hard, and with growth-rings defined by zones of light-colored mucilage fibers. The vessels are visible with lens, grouped 1-5+ together, and have simple perforations. The lumina are open and readily permeable to alcohol. The rays are 1-2 cells broad, 1-40+ cells high, and heterogeneous. The fibers are thick-walled and lignified in zones. Wood-parenchyma is not abundant.

Order MALVALES

Family ELAEOCARPACEAE

This family comprises 7 genera of general distribution in the Tropics. Constant anatomical characters are lacking in the family. Both scalariform and simple perforations of the vessels occur and spiral markings may be present or absent. The rays are from one to several cells in breadth. Simple or narrowly bordered pits occur in the wood-prosenchyma, which is generally thin-walled and often septate. Wood-parenchyma is generally present and is often found abundantly.

Elaeocarpus bifidus Hook. et Arn. KALIA.

Material, xxxi :81 :1433.

The genus consists of more than 60 species of trees with only *Elaeocarpus bifidus* occurring in Hawaii. This is an endemic species, reaching a height of 40 feet and a D. B. H. of 1 foot. It is confined to wet or boggy situations at elevations of 3,500-4,000 feet, and common on Kauai in association with Straussia, Bobea, *Cheirodendron platyphyllum*, *Cryptocarya mannii*, and *Pelia*. The bast is strong and is made into cordage.

The dry wood is whitish or blue-gray, soft, fine and even textured, fairly straight-grained, and without macroscopic growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with lens, and mostly in small radial groups. The rays are visible under lens, straight, smaller than the pores.

Minute.—The vessels are of rather uniform diameter (0.12± mm.), with few tyloses, and grouped radially 2-6 together or sometimes side by side tangentially. A few vessels are isolated. Lateral perforations (cf. fig. 7 *a*) occur. The rays are straight or only slightly curved, 1-4+ cells broad, and slightly resinous. The pits are numerous, subcircular, rather small, 0.001-0.004+ mm. in diameter. The prosenchyma cells have walls of medium thickness (0.004 mm.), wide lumina, and are in rather definite radial arrangement. Growth-rings are indistinctly indicated by slight compression of one or more rows. Wood-parenchyma is sparingly developed and is mostly in contact with the vessels.

RADIAL SECTION

Gross.—The vessel groups are visible without lens, appearing as brownish lines. Lateral perforations are large and may be seen with a lens. The rays are 1.± mm. high, brownish in color, resinous, and plainly visible without lens.

Minute.—The radial walls of the vessels bear large irregular bordered, semibordered, or simple elliptical and some greatly elongated almost scalariform pits. Large elliptical or sometimes circular lateral perforations occur. Tyloses are sometimes observed. The rays are resinous. The cells in the interior portion of the wide rays are elongated radially. Those on the sides and especially the margins, are elongated axially. Some marginal cells extend vertically into pointed cells 0.24+ mm. high with a radial diameter of 0.03+ mm. The pits on the radial walls in contact with prosenchyma have long slitlike orifices. Pits on walls of adjacent ray-cells are circular or elliptical in outline and 0.001-0.006+ mm. in diameter. Walls in contact with vessels bear irregular, commonly greatly elongated, broadly semibordered or simple pits often 0.045+ mm. in length.

The prosenchyma walls bear numerous very narrowly bordered pits with crossed lenticular orifices exceeding the border. There are no septae. The wood-parenchyma cells are few, elongated, and mostly in contact with the vessels. The sides in contact with vessels bear long, transverse, elliptical, broadly semibordered or simple pits.

TANGENTIAL SECTION

Gross.—The rays are dark-colored, fine, but visible without lens. The vessels are visible with lens.

Minute.—The common walls between vessels bear large irregular distinctly bordered pits that vary from circular to elliptical or even scalariform in outline. The rays are from 1-4+ cells broad and 1-24+ cells high. The cells vary greatly in outline and size, with the smallest generally on the interior of the ray and the largest and highest on the sides and margins. The tangential walls of the prosenchyma cells have fewer pits than the radial walls.

MACERATION

The vessel segments are variable in length, but are not often more than 0.7 mm. long. The ends are generally oblique, and the perforations simple and generally elliptical in outline. Transverse circular perforations are uncommon. A tonguelike projection of variable length is commonly present, often from both ends of the segment. Many lateral perforations occur. The prosenchyma is composed of fibro-tracheids reaching a length of 1.4+ mm. and tapering from near the middle. The pit markings generally extend to within a short distance of the end. The pit orifices are commonly long, slitlike and oblique.

DISTINGUISHING CHARACTERS

The dry wood is whitish or bluish-gray in color, diffuse porous, fine and even textured, and with microscopic growth-rings. The vessels are small, not visible without lens, with few tyloses, and simple large circular or generally elliptical perforations. The pits are large and vary from circular to scalariform. The prosenchyma is composed of medium thin-walled fibro-tracheids with very narrowly bordered pits. A few elongated wood-parenchyma cells occur in contact with the vessels.

Family MALVACEAE

The Malvaceae are herbs, shrubs, or trees of wide distribution. The wood is soft in the Hawaiian representatives, characterized by vessels with simple perforations and bordered, semibordered, or simple pits. The rays are 1-9 cells broad. Wood-parenchyma is abundant in some genera. The fibers may have thin or thick walls or bordered or simple pits.

Hibiscus arnottianus Gray. KOKIA. Material, xxxv:26:1435 (2 of new series).

This species is endemic to Hawaii, growing mainly along streams. The wood is dull yellowish-white or blue-gray in the narrow sapwood zone, soft, diffuse porous, and with macroscopic growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with lens, and mostly in small radial groups. The lumina are open and permeable to alcohol. The rays are as broad as the vessels.

Minute.—The vessels are thin-walled, rather variable in diameter, few more than 0.16 mm., and mostly grouped 2-8+ together radially, and occasionally as many as three wide tangentially are observed. Some compact groups of 6-10 or more are formed, which are nearly circular in outline. The rays are 1-5+ cells broad, thin-walled, and have numerous small circular pits in imperfect radial rows. The fibers are of large diameter, rounded polygonal in outline, and arranged more or less in radial rows. The walls are thin, and have small simple pits in both radial and tangential sides. Growth-rings are defined by a slight compression of narrow zones of fibers and associated elements. Wood-parenchyma cells are of the same diameter as the fibers, slightly thinner walled, and diffusely distributed.

RADIAL SECTION

Gross.—The rays are plainly visible without lens, light-colored, and less than 2 mm. high. The wood is straight-grained and has a fine uniform texture.

Minute.—The elements are serried. Most of the vessels are somewhat constricted at the ends; the perforations, simple; the pits, circular uniform in size and with lenticular orifices. The fibers bear numerous small simple pits with oblique slitlike orifices in the radial walls. Wood-parenchyma cells are common, diffuse, 0.15± mm. long, and have numerous small circular pits 0.003 mm. in diameter. The rays are composed mostly of radially elongated cells, some with square or axially elongated cells at the margins or other portions of the ray. The pits are numerous, circular in outline, and 0.003± mm. in diameter.

TANGENTIAL SECTION

Gross.—The rays are visible but not prominent under a lens. The vessels are barely visible without a lens.

Minute.—The rays are 1-5+ cells wide and 1-50+ cells high. The cells are rounded in outline and nearly of uniform size. Sometimes slightly elongated cells are observed at the margin or other portions of the wide rays and generally in the uniseriate rays.

MACERATION

The fibers are of wide diameter, and long. The central third length is cylindrical. The ends taper at first abruptly into long, attenuate points. The pits are mostly confined to the central cylindrical portion. Long oblique slits are common in the inner layer of the wall.

DISTINGUISHING CHARACTERS

The wood is dull yellowish-white in color, soft, diffuse porous, and without macroscopic growth-rings. The vessels are visible with lens, mostly grouped, often compactly, 2-8+ together, thin-walled, and with simple perforations and bordered or semibordered pits. The lumina are open and permeable to alcohol. The rays are 1-5 cells broad, 1-50+ cells high and imperfectly heterogeneous. The fibers are of large diameter and long; the walls thin and with simple pits. Wood-parenchyma is fairly abundant and diffuse.

Gossypium drynarioides Seem. KOKIA.

Kokia drynarioides (Seem.) Lewt.

Material, xxxvi:65:1434.

This species is now nearly extinct, but a variety occurs in Oahu. It grew formerly on the west end of Molokai.

The wood is light yellowish-brown in color, streaked with reddish- or blackish-brown, soft, diffuse porous, without macroscopic growth-rings, and of fine, even texture.

CROSS SECTION

Gross.—The vessels are visible with a lens and mostly grouped 2-8+ together radially or to some extent tangentially. The lumina are without tyloses, but brownish contents may be present. The rays are brownish and as broad as the vessels. Fine reddish tangential lines of wood-parenchyma are visible with lens.

Minute.—The diameter of the vessels is variable, but seldom is found to exceed 0.18 mm.; the walls, thin; the lumina, often closed with a deep-staining resinlike material. The rays are 1-7 cells broad; the cells variable in length and width; the pits, numerous and very small; the cell cavities, with resinlike globular or massive material. Wood-parenchyma cells are of the same diameter as the fibers and arranged in narrow tangential lines 3± cells wide. The vessels are surrounded by wood-parenchyma. Slightly compressed lines of wood-parenchyma and fibers indicate indistinct growth-rings. The fibers are rounded in outline, and arranged in a regular order of small and large diameters. The walls are thin and the pits simple.

RADIAL SECTION

Gross.—The rays are reddish-yellow, less than 2 mm. in height, and plainly visible without lens. Faint longitudinal striations due to fine vertical lines of wood-parenchyma are visible in good light or distinct under a lens.

Minute.—The vessels generally bear elongated slitlike pit apertures; the segments are short; the perforations, simple. The pits, where in contact with the rays, are circular or elliptical or elongated. Most of the orifices on the vessel side are slitlike and many are elongated. Wood-parenchyma cells are 0.15± mm. long. The fibers bear numerous simple pits with long slitlike orifices. The rays are composed mainly of radially elongated cells of variable low height. Square or axially elongated cells occur irregularly at the margins and other portions of the rays.

TANGENTIAL SECTION

Gross.—Under a lens a mottled appearance is produced by the reddish-yellow wood-parenchyma zones.

Minute.—The rays are of an irregular elliptical outline, and composed of cells of irregular size and shape. The walls are thin, and deep-staining resinlike contents are present in the cell cavities. Some of the fibers bear pits in the tangential walls.

MACERATION

The vessel segments are short and truncate. The walls bear elongated slitlike pit markings of variable length. The fibers are short, cylindrical in the central portion, and taper abruptly into long, attenuate points.

DISTINGUISHING CHARACTERS

The wood is yellowish-brown, soft, diffuse porous and without macroscopic growth-rings. The vessels are visible with lens, mostly grouped 2-8+ together, and composed of short segments with large simple, single perforate ends. The rays are 1-7+ cells broad, 1-40+ cells high, and irregularly heterogeneous. The cell cavities contain a resinlike material. Wood-parenchyma occurs in narrow tangential lines. The wood-fibers are thin-walled, short, and bear simple pits.

Order PARIETALES

Family GUTTIFERAE

The Guttiferae are a family of tropical plants, mainly trees and shrubs, of which only one genus, Hypericum, occurs outside the Tropics. Many species yield edible fruits. The vessels bear either simple or semi-bordered pits in contact with the rays; the perforations are simple; the rays are 1-4 seriate. The prosenchyma pits have narrow borders; chambered crystal-parenchyma occurs in a few genera.

Calophyllum inophyllum Linn. KAMANI.

Material, xxxii:20:1441.

The genus Calophyllum consists of 55 species mainly in the Tropics of the Old World; four species occur in American Tropics. *Calophyllum inophyllum* is indigenous to the Hawaiian islands, and occurs as a littoral species in tropical Asia and Polynesia. It yields a resin called tacamahak. The tree attains a height of 50-60 feet, and yields wood of value for cabinet or special construction work.

The wood is red in color becoming slightly lighter in shade in the sapwood, diffuse porous, without growth-rings, resinous, rather soft, fine and even textured, cross-grained, and is easily worked.

CROSS SECTION

Gross.—The vessels are scarcely visible without lens, much larger than the rays, generally solitary, and contain more or less resin and tyloses, but are not completely filled. The rays are very fine, reddish, and visible under a lens. Wood-parenchyma occurs in wavy tangential lines as broad as the pores.

Minute.—The vessels are solitary, circular or elliptical in outline, rather even in size, and 0.18± mm. in diameter. The cavities contain more or less resin and tyloses. The rays are mainly uniseriate, and composed of elongated cells, filled with resin. The pits are small, rather numerous, subcircular, and 0.003± mm. in diameter. The prosenchyma cells vary greatly in size, outline, and arrangement. The lumina are wide, and resinous. The walls are 0.003± mm. in thickness, and obscurely pitted. The wood-parenchyma is metatracheal, resiniferous, composed of cells of greater radial diameter than the prosenchyma cells, and arranged in broken, wavy, tangential lines, 4± cells wide.

RADIAL SECTION

Gross.—Lines of dark-red wood-parenchyma visible without lens and as wide or wider than the vessels alternate with the lighter colored prosenchyma, appearing as fine striations. The rays are fine, but visible without lens. The elements are filled with a resinlike body.

Minute.—The vessels are composed of short, often bulging segments, 0.5± mm. in length, and with circular medium-sized bordered pits 0.003± mm. in diameter with lenticular, transverse or oblique orifices; or, in contact with the rays, large irregular circular or broadly elliptical simple pits, 0.003-0.015+ mm. in diameter. The perforations are simple, and the plane of perforation is transverse or somewhat oblique. Tyloses and resin are present in the lumina. The rays are composed mainly of radially elongated resinous cells. The marginal one or more rows consist of irregular cells, many slightly elongated axially. The radial walls bear large irregular simple pits which are circular, squarish, or elliptical in outline, in contact with vessels. The prosenchyma cells are intercrossed, many resinous, minutely pitted, and nonseptate, but often found to contain septalike resin plates. The wood-parenchyma occurs in bands 4± cells wide, and is composed of axially elongated resinous cells, whose radial diameter greatly exceeds that of the prosenchyma. The walls bear numerous rather irregular pits 0.006± mm. in diameter.

TANGENTIAL SECTION

Gross.—The surface is mottled by areas of dark-colored wood-parenchyma. The rays are fine and visible with a lens.

Minute.—The rays are mainly uniseriate and composed of rounded squarish cells, generally with a slightly elongated obtusely pointed cell at each margin.

MACERATION

The vessel segments are short, some of them bulging, and with large circular simple perforations. The plane of perforation is transverse or slightly oblique, and the end of the segment is often found to bear a slender tonguelike projection. The pit markings are in axial rows except for the large simple pit markings corresponding to the ray vessel pits. Numerous long tracheids occur. The prosenchyma is composed of rather thin-walled fibers 0.1± mm. long, tapering rather irregularly from near the middle. The pits are small, not numerous, and with slitlike, generally oblique orifices.

DISTINGUISHING CHARACTERS

The wood is resinous, rather soft, red in color, with slightly lighter sapwood, diffuse porous, without growth-rings, and fine textured. All elements are resinous. The vessels are isolated, barely visible without lens, short segmented, with tyloses, simple perforations and with both bordered and simple pits. Numerous tracheids occur. The rays are mainly uniseriate, with coarse simple pits in contact with the vessels. The cells are chiefly elongated radially; the marginal cells are slightly elongated axially. The wood-parenchyma occurs in wavy tangential lines 4± cells wide, which are visible without lens. The wood-prosenchyma is composed of rather thin-walled fibers of medium length, with small simple pits.

Family FLACOURTIACEAE

This is a tropical family of 70 genera of trees and shrubs, without representatives in Europe or North America. Nearly all inhabit the lowlands. The family is represented in Hawaii by two species of Xylosma.

Both scalariform and simple perforations occur in the vessels and spiral thickenings occur in Ryania. Septate fibers have been found in certain genera. The fibers may possess either simple or bordered pits, and mucilage-reacting inner lamellae occur in some genera.

Xylosma hawaiiense Seem. MAUA. Material, xxx:4:1442.

This genus is distributed in the Tropics of both Hemispheres with the exception of Africa. There are 42 species, two of which are Hawaiian. *Xylosma hawaiiense* is endemic to Hawaii, growing to a height of 30 feet with a D. B. H. of 1 foot. It occurs in the lower forest zone mainly on the arid leeward sides of the Islands in association with *Alphitona excelsa, Dracaena aurea,* and *Santalum pryrularium.*

The wood is reddish-brown with narrow zones of light and dark shades resembling narrow growth-rings. The wood is diffuse porous, fine and fairly even textured, and rather hard. The wood is rather heavy but very brittle.

CROSS SECTION

Gross.—The vessels are visible with lens, diffuse, mostly in small groups, and larger than the rays. The rays are visible with lens, and reddish in color.

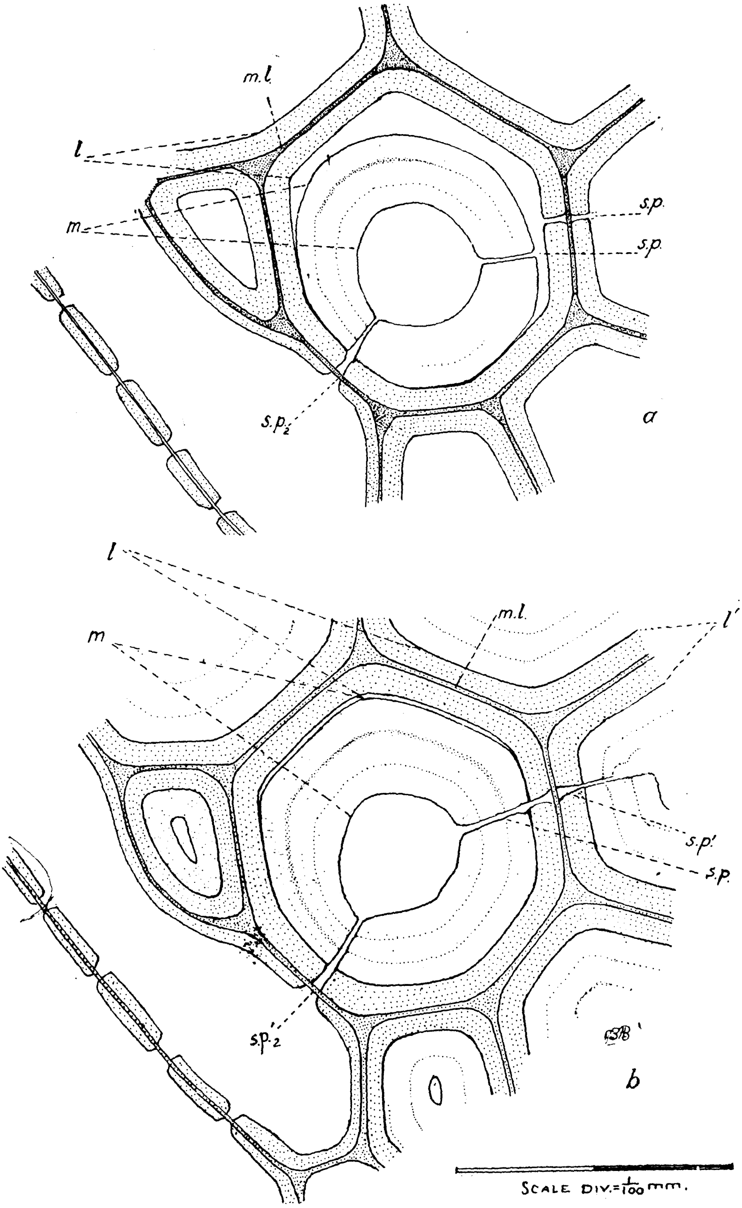

FIGURE 5. **a**, A laminated fiber of *Xylosma hawaiiense,* × 3,000 diameters, after desiccation; **b**, the same after being covered with water for 45 minutes, showing lignified outer layer (**l**), laminated mucilage-reacting layer (**m**), simple pit (**sp**), middle lamella (**ml**).

FIGURE 5. **b**, shows that after treatment with water all layers of the fiber are swollen, but the mucilaginous layers (**m**) more than the lignified layer (**l**). The simple pit (**sp**) comes into alignment after soaking. The simple pit (**sp** 2) remains permanently in connection.

Minute.—The vessels are rather uniform in size, 0.07± mm. in diameter, part of them isolated, and part grouped in small radial groups or with occasional vessels adjacent tangentially; tyloses are few; lateral perforations are present between tangentially adjacent vessels. The rays are narrow, 1-2+ cells wide, and composed of narrow elongated cells usually in two rows. Wider less elongated cells occur, usually in one row. The cell-walls are thin, 0.002± mm., and bear small subcircular pits, 0.001-0.004+ mm. in diameter. The cavities contain a resinlike body and some of them large mineral crystals.

The fibers occur in nearly regular radial arrangement and have rather thick (0.009± mm.) walls, with simple pits mostly in the radial sides. Zones of fibers possess a laminated structure of the wall. The outer layer of such fibers shown, in *l* and *l'* of figure 5, *a* and *b*, in which the outer layers of two adjacent fibers are shown separated by the middle lamella *m l*, is lignified, stains with safranin, and shrinks slightly in dehydration. The inner laminated layer, *m*, *m*,' stains, variously but usually less deeply than the outer layer, shrinks greatly (*m*) on dehydration and swells without going into solution in water (*m l*) and responds to other mucilage tests. Alternating with such zones of mucilage-reacting fibers are fibers of the same dimensions, but whose walls are not lamellated and react strongly to tests for lignin. Chemical growth-rings are defined by the phloroglucinol hydrochloric acid test.

Wood-parenchyma is sparingly developed and is mostly in contact with the vessels.

RADIAL SECTION

Gross.—The radial surface is uniform in texture and color. The rays are not prominent even under a lens.

Minute.—The vessels have frequent lateral perforations. The segments are rather long (1.3± mm.), the plane of perforation generally somewhat oblique, the perforations simple and elliptical, or rarely circular, in outline. The radial walls are largely in contact with ray-parenchyma, and bear rather small semibordered pits with transverse or oblique open lenticular orifices. Occasionally simple pits of large size and irregular outline occur. The uniseriate portions of the rays are composed mainly of high cells two or three times as high as their radial diameter. The biseriate portions are composed of radially elongated cells. The cavities are filled with a deep staining body and some have single large mineral crystals. The radial walls in contact with the vessels generally bear rather small circular semibordered pits with lenticular orifices, but larger, commonly elongated simple pits occur. The fibers are septate; the pit orifices long, slitlike, and vertical.

TANGENTIAL SECTION

Gross.—The surface is uniform in color and texture. The rays and vessels are visible but not prominent under a lens.

Minute.—The rays are mainly uniseriate or uniseriate in part, or 1-2+ cells wide and 1-50+ cells high. The uniseriate portions consist of axially elongated cells. A small portion, often less than one-third the height of the ray, is usually biseriate, consisting of small elliptical cells. The common walls between vessels bear numerous bordered pits of medium size with oblique or transverse lenticular or slitlike orifices. The prosenchyma walls bear few pits.

MACERATION

The vessel segments are generally rather long (1.3± mm.), and the ends more or less oblique, projecting beyond the perforation into a hollow or solid tapering end. The terminal perforations are commonly elliptical. The pits on the radial walls generally occur in grouped areas corresponding to the shape and size of the ray-cells with which they were in contact. The prosenchyma fibers taper from near the middle. The laminated fibers are extremely brittle and break with a conchoidal fracture except for the outer thin layer which generally splinters.

DISTINGUISHING CHARACTERS

The wood is reddish, with narrow zones of light and dark shades, diffuse porous, even textured, easily cut, heavy but brittle. The vessels are visible under a lens, and arranged mostly in small groups. The lumina are without tyloses; the perforations, simple. The pits are rather uniform in size (0.006± mm.) and subcircular, with lenticular orifices. The rays are mainly uniseriate or uniseriate in part. The prosenchyma is septate, rather thick-walled, and laminated for the most part. Wood-parenchyma is very sparingly developed, and mostly adjacent to vessels.

Order MYRTIFLORAE

Family THYMELAEACEAE

This is a small family, consisting of 455 species of shrubs or trees or rarely herbs, of general distribution. *Dirca palustris,* the moose-wood, is a familiar American representative of this family. The secondary wood is characterized by vessels with simple perforations, and bordered or semibordered pits. Spiral thickenings occur in some of the genera. Wood-parenchyma is generally not abundant. The wood-prosenchyma generally has wide lumina and bordered pits. The medullary rays are 1-2 cells wide.

Wilkstroemia sandwicensis Meisn. AKIA. Material, cvii:xi:1473.

The akia is endemic to the Hawaiian islands, and is most abundant on the lava fields of Hawaii, or at elevations of 5,000 feet in association with koa. It is a small tree 30 feet high. The wood is dull grayish or bluish-white, diffuse porous, very soft, and without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, isolated or grouped 2-3+ in compact groups, both in radial and tangential directions. The lumina are open and very permeable to alcohol. The rays are visible with lens, smaller than the vessels.

Minute.—The diameter of the vessels is rather variable, but rarely exceeds 0.12 mm. The walls are thin, of nearly the same thickness as the fiber walls. The fibers are rounded polygonal in outline, of large diameter, have very thin walls, and are irregularly arranged. The rays are 1-2 cells wide and bear subcircular pits of medium size.

RADIAL SECTION

Gross.—The surface has a dull luster. The rays and vessels are not prominent even under a lens.

Minute.—The elements are serried. The vessel segments are of uniform length. The pits are bordered or semibordered, circular in outline with lenticular orifices in the vessel walls, and of uniform diameter whether in contact with ray-cells or other elements. The perforations are simple and of nearly the diameter of the vessel lumen. The plane of perforation is transverse or nearly so. The rays are homogeneous; the cells, composed of thin-walled cells of moderate radial length; the pits, medium sized and subcircular. The orifices of the semi-bordered pits formed in contact with the vessels are circular in the ray walls, and of a diameter equal to the length of the lenticular orifices in the opposite vessel walls. The prosenchyma cells bear bordered pits with lenticular orifices. Wood-parenchyma is little developed.

TANGENTIAL SECTION

Gross.—Faint longitudinal lines indicating vessel groups are visible without lens. The rays are small and visible with a lens.

Minute.—The rays are linear, with obtuse ends, 1-2 cells broad and 1-23+ cells high. The cells are rounded outline and of nearly uniform size. A few bordered pits are present in the tangential walls of the prosenchyma.

MACERATION

The prosenchyma is composed of short fibro-tracheids, with a central cylindrical portion of large diameter, from which the ends taper irregularly into sharp points.

DISTINGUISHING CHARACTERS

The wood is dull grayish-white in color, diffuse porous, very soft, and without distinct growth-rings. The elements are serried. The vessels are visible with a lens, isolated or in small rather compact groups, and bear either bordered or semibordered pits which are of uniform size. The perforations are simple. The rays are homogeneous, 1-2 cells wide and 1-23+ cells high. The prosenchyma is composed of short, thin-walled fibro-tracheids of large diameter, with bordered pits. Wood-parenchyma is sparingly developed. The wood is readily distinguished from that of *Eugenia jambolana,* an introduced species, which has wider and more regular lines of nonresinous wood-parenchyma easily visible in cross section without lens, and vessels reaching 0.3 mm. in diameter, or twice the diameter of the vessels of *E. sandwicensis*. Also, the lumina of the vessels are open and readily permeable to alcohol.

Family COMBRETACEAE

A family of woody plants, trees and shrubs, of wide distribution throughout the Tropics. There are three genera in Australia. Most of the members of this family yield tannin and some species, as *T. catappa,* yield dyes, or may be used for lumber. The seeds of some species are edible.

The wood is characterized by narrow medullary rays. The vessels are isolated, rarely grouped, and have bordered or semibordered pits even in contact with parenchyma. The wood-prosenchyma is characterized by simple, rarely bordered pits; some is septate, and may contain crystals. The wood-parenchyma is vasicentric, and may occur in tangential lines as in *Terminalia belleria*. Some species of Terminalia have chambered crystal-bearing parenchyma. Intercellular cavities may occur in the xylem (17), and interxylary phloem has been recorded for some species.

Terminalia catappa L. KAMANI. Materials, xxxiii:45:1509.

The genus comprises over 100 species widely distributed in the Tropics, none of which are indigenous to Hawaii. *Terminalia catappa* has been introduced to the islands and widely planted because of its large size and other desirable characters. The fruit yields tannin, and the oily seeds are edible. This species is indigenous to Madagascar, the Malay Archipelago, and New Guinea, where it is characteristic of the littoral forest growth.

The wood is light brownish-yellow with a waxy luster, soft, fairly even textured, cross-grained, and with growth-rings visible without lens. Dark tangential streaks occur in some of the growth-rings.

CROSS SECTION

Gross.—Growth-rings are defined by dark zones of late-wood sometimes containing circular cavities in zonal arrangement, plainly visible under a lens and filled with a yellowish substance. The vessels are diffuse, dark-colored, visible without lens and without tyloses. The rays are barely visible without lens; tangential lines of wood-parenchyma occur throughout the ring.

Minute.—Growth-rings defined mainly by great increase in thickness of the fiber walls, with slight radial compression. The vessels are solitary for the most part, some of them in radial groups of 2-3+, nearly circular in outline except where grouped, rather uniform in size and sometimes 0.3± mm. in diameter with slightly thickened (0.006± mm.) walls. The lumina are usually empty; the perforations, simple. The rays are 1-2+ cells wide and curve slightly around the vessels. The cell cavities are filled with brownish contents. The wood-fibers are polygonal in outline, with thin walls in early-wood and thick walls (0.006+ mm.) in late-wood, with large lumina throughout. The pits are simple. Wood-parenchyma cells surround the vessels, form broken tangential lines or extensions from the sides of the vessels, and generally contain a brownish material (fig. 6 *a*, *mp*, *vp*). There are many idioblasts with clustered crystals of calcium oxalate (fig. 6 *c*).

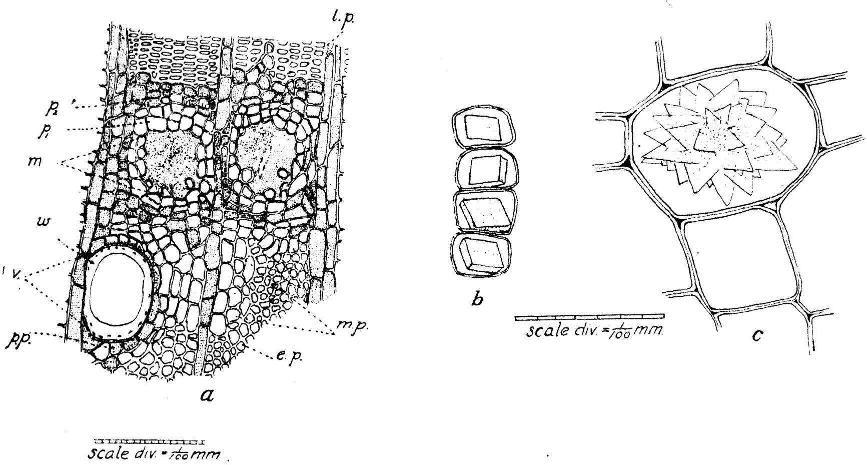

FIGURE 6. **a**, Cross section of *Terminalia catappa* wood showing: mucilage canal (**m**); isodiametric parenchyma layer (**p 1**); compressed parenchyma layer, with cell content (**p 2**); paratracheal parenchyma (**pp**); axially elongated metatracheal arenchyma (**mp**); vessel (**v**); perforate endwall (**w**). **b**, Crystal-parenchyma of *Maba sandwicensis* wood with rhombohedral crystals. **c**, Idioblast with clustered crystals in wood-parenchyma of *Terminalia catappa*.

RADIAL SECTION

Gross.—The grain is irregular. Both rays and vessels are visible to the eye, and reddish or brownish in color. Intercellular cavities, when present, are easily visible without lens.

Minute.—The vessels bear numerous relatively coarse, indistinctly circular, elliptical, or hexagonal pits of 0.009+ mm. in diameter with broadly lenticular transverse or oblique orifices on all sides whether in contact with vessels or parenchyma. Those communicating between vessels are indistinctly bordered; those between vessels and parenchyma, narrowly semibordered. The segments are short, 0.36± mm., and the plane of perforation is transverse. Perforations are simple and mainly terminal. The rays are homogeneous, composed of radially elongated cells, 0.18± mm. in length, and 0.02± mm. in height. The walls are thin, and bear numerous coarse circular or elliptical pits 0.006± mm. in diameter. The prosenchyma fibers are nonseptate, minutely pitted, and intercrossed. The metatracheal wood-parenchyma cells are typically elongated, 1.2 mm. in length. The wood-parenchyma cells in contact with the vessels are shorter, 0.06± mm. in length, and often somewhat irregular in shape. There are many globular idioblasts with clustered crystals of calcium oxalate.

TANGENTIAL SECTION

Gross.—The vessels, with the cells surrounding them, form conspicuous dark reddish-yellow lines. The rays, visible with a lens, form numerous short, narrowly linear, acutely pointed, dark-colored markings of the same dark color as the vessels.

Minute.—The rays are 1-2, rarely 3+ cells wide, 1-30+ cells high, and homogeneous. The cells are of rather uniform size, and shape, 0.015 mm. in tangential diameter and 0.27± mm. high. The marginal cell is generally somewhat higher than the average. The wood-fibers are less intercrossed than in the radial plane. Secretory cavities are sometimes found, formed possibly traumatically. In the material examined, but one ring contained them, and these were in a continuous row on the outer face of a zone of late-wood (fig. 6, *a*). In cross section, the cavities are circular or elliptical and 0.1 mm. in radial diameter; the tangential diameter varies from 0.1 to 0.06+ mm. The cavities are filled with a viscous substance appearing deep yellow by transmitted light, staining deep red with safranin. The first one or two layers of cells lining the cavities are thin-walled, numerously pitted, isodiametric, usually empty parenchyma cells (fig. 6, *a*). Exterior to these occur one or more rows of cells with viscous contents, compressed transversely and more or less elongated axially. In tangential section these cavities are found to be confluent into one which occupies all the space except for the medullary rays which are bounded on the sides by the parenchyma layers above described. Some of the rays, as seen in the transverse section, are interrupted by the cavity, but continue on the opposite side.

MACERATION

The vessel segments are short, of large diameter, generally cylindrical, with transverse ends sometimes with a tonguelike projection from one end or rarely both ends. The pit markings are nearly uniform in size, and rather coarse. The fibers are attenuate from near the middle, usually more or less curved, minutely pitted, sharp pointed, and attain a maximum length of 1.6+ mm. The rays are 1-2 cells wide and 1-30+ cells high.

DISTINGUISHING CHARACTERS

The wood is brownish in color, soft, fairly even textured, cross-grained, diffuse porous, and with growth-rings. The vessels are generally single, visible without lens, without tyloses, and with simple perforations. The segments are short; the plane of perforation, transverse. The rays are 1-2+ seriate, 1-30+ cells high, and homogeneous. Wood-parenchyma occurs in contact with the vessels and in broken tangential lines. Idioblasts with clustered crystals are many. The fibers are minutely pitted, nonseptate, of medium length, and attenuate from near the middle.

Family MYRTACEAE

The Myrtaceae are evergreen shrubs or trees of which there are over 2,700 species confined to tropical or near tropical climates. The myrtle, Eucalyptus, *Psidium guayava,* and *Eugenia caryophyllata,* the unopened flower buds of which are the cloves of commerce, belong to this family.

The wood is characterized by vessels with simple or scalariform perforations, and bordered, semibordered, and sometimes simple, pits. The rays are 1-3 cells broad. Wood-parenchyma varies in amount according to the species. Bordered pits occur in the fibers.

Eugenia malaccensis L. OHIA AI, mountain apple.

Jambosa malaccensis (L.) P. DC.

Material, lv:15:1453.

This species is of general distribution in the Pacific islands and is believed to have been introduced to Hawaii in prehistoric times by primitive man. It grows at low elevations on the windward side of the islands. The tree reaches a height of 60 feet. The fruit is edible.

The wood is reddish- or yellowish-brown in color, soft, without growth-rings, diffuse porous, of even texture, straight-grained, and in former times was used by the Hawaiians especially to carve into idols, and for other sacred purposes.

CROSS SECTION

Gross.—The vessels are barely visible without a lens, very numerous, isolated, or in small radial groups of 2 or 3, or rarely more. The lumina are open and readily permeable to alcohol. The rays are much narrower than the vessels and visible only with a lens. Tangential lines of wood-parenchyma are visible with a lens.

Minute.—The size of the vessels is slightly variable but the diameter rarely exceeds 0.2 mm.; the walls are very thin, and the outline is generally angular. The rays are 1-3+ cells broad and curve but slightly near the vessels. The pits are circular in outline and variable in diameter up to 0.009+ mm. but are obscured by resinlike contents which fill the cell cavities. The fibers are of medium diameter, many somewhat compressed tangentially, and arranged in radial rows. The walls are of medium thickness (0.005 mm.). The lumina commonly contain globules of resinlike material. Wood-parenchyma cells are thin-walled, of about twice the radial diameter of the fibers, are seldom compressed, and occur in numerous tangential bands 4± cells wide alternating with bands of fibers of nearly equal width. The vessels are largely in contact with rays or wood-parenchyma.

RADIAL SECTION

Gross.—The rays are reddish in color and visible without a lens. The alternation of wood-parenchyma and fiber zones is visible but indistinct under a lens.

Minute.—The vessels are composed of segments of medium length with simple circular perforations, generally somewhat smaller than the vessel lumen. The bordered pits between vessels are generally crowded hexagonal in outline, 0.009 mm. in diameter, and with transverse lenticular orifices. Pits between vessels and ray-cells are irregularly elliptical in outline varying from widely to narrowly semibordered or simple, and varying from 0.009 mm. to 0.03 mm. in diameter. True simple ray vessel pits are common. Simple pits are also common between vessels and adjacent wood-parenchyma. Wood-parenchyma cells are 0.09 mm. in length in contact with vessels or 0.27± mm. in the metatracheal zones. The fibers bear a few bordered pits with lenticular orifices. The rays are composed of three types of cells: (1) very low radially elongated cells present in the multiseriate portions; (2) higher, less elongated cells forming the larger part of the uniseriate portions of the rays; and (3) axially elongated cells often present at the margins.

TANGENTIAL SECTION

The rays are linear in outline, acutely pointed, 1-3+ cells wide and up to 50+ cells high. The rays are mainly uniseriate in part, with one or more multiseriate portions at irregular intervals. The uniseriate portion is composed of large rounded four-sided cells with often an axially elongated cell at the margin. The multiseriate portions are composed of small subcircular cells. There are few if any pits in the tangential walls of the fibers.

MACERATION

The fibers are nearly straight and taper gradually into long, attenuate, very sharp ends. Irregular simple pit markings are numerous in the vessel walls.

DISTINGUISHING CHARACTERS

The wood is reddish- or yellowish-brown in color, soft, without growth-rings, diffuse porous, and straight-grained. The vessels are barely visible with lens, numerous, isolated or in small groups, have simple perforations and bordered, semibordered, and simple pits communicating with the adjacent elements. The rays are linear in tangential section, and mainly uniseriate in part, 1-3+ cells wide and up to 50+ cells high. The cell cavities contain a resinlike material. The fibers bear bordered pits, have moderately thickened walls, and occur in narrow zones alternating with wood parenchyma.

Eugenia sandwicensis Gray. OHIA HA. Material, lix:71:1457.

Syzygium sandwicense (Gray) Ndz.

E. sandwicensis is endemic to Hawaii, occurring throughout the group. It occurs on the lowlands and up to 4,000 feet. In the rain forest it attains a height of 60 feet and a diameter of 18 inches. The fruit is edible; the bark yields a black dye. The wood is durable, rather hard, reddish-brown in color, diffuse porous, and possesses an irregular grain.

CROSS SECTION

Gross.—There are no growth-rings. The vessels are small, visible with a lens, numerous, isolated or grouped very compactly 2-6+ together in both tangential and radial directions. (There are many lateral perforations.) The lumina in heartwood become partly filled with tyloses or resinlike material and are only slightly permeable to alcohol. The rays are small and visible with a lens. Wood-parenchyma occurs in numerous tangential extensions from the radial sides of the vessels.

Minute.—The vessels are nearly circular in outline where isolated, or variously compressed where grouped. The size is variable but rarely exceeds 0.14 mm. The walls are thin, and lateral perforations are common. The rays are 1-3+ cells wide and filled with resinlike material. The fibers are rounded polygonal in outline with moderately thick walls and lumina often filled with resin. Wood-parenchyma cells of nearly the same diameter as the fibers, but thin-walled, are associated with the vessels and extend tangentially in irregular areas nearly as wide as the vessels and alternate with tangential lines of fibers.

RADIAL SECTION

Gross.—The vessels are composed of long segments. Perforations are simple, usually circular and nearly as large as, or smaller than the vessel lumina. Lateral perforations are frequent. The pits are variable in size and shape. Bordered pits in the common vessel walls vary from circular to elliptical or elongated with lenticular or slitlike orifices. Pits between vessels and parenchyma or ray cells vary from semibordered to large and simple. The rays are heterogeneous with radially elongated cells in the wide portions and axially elongated cells at the margins or uniseriate portions. The pits are usually obscured by resin but are large, elliptical, and narrowly semibordered or simple in contact with vessels. In contact with wood-parenchyma or other ray-cells, the pits are smaller and subcircular. The fibers bear a few narrowly bordered or simple pits with slitlike orifices. A resinlike material commonly obscures the pitting. Wood-parenchyma cells are 0.15± mm. in length and usually filled with massed material.

TANGENTIAL SECTION

Gross.—Wood-parenchyma, rays, and vessels are visible under a lens, with garnet-colored contents.

Minute.—The rays are 3+ cells wide, 25+ cells high, and irregularly linear or linear-elliptical in outline. The cell cavities are filled with a deep staining resinlike material which in some of the cells radiates in lines from the center.

MACERATION

The fibers are long (2± mm.) and taper into long attenuate sharp points.

DISTINGUISHING CHARACTERS

The wood is reddish-brown in color, diffuse-porous, rather hard, and with an irregular grain. The vessels are small, visible with a lens, isolated or grouped compactly 2-6+ together, and with simple perforations and bordered, semibordered, and simple pits. The lumina become more or less filled with tyloses or resinlike material. The rays are heterogeneous, 1-3 cells wide and 1-25+ cells high. The fibers are rather thick-walled and alternate in irregular tangential lines with wood-parenchyma and vessels. A garnet-colored substance is present in the rays, wood-parenchyma, fibers, and vessels.

Metrosideros villosa Smith. OHIA LEHUA.

Metrosideros polymorpha Gaud.

Material, lvi:42:1455.

The genus comprises about 40 species of trees or shrubs of which two-thirds are peculiar to Australia and New Zealand. Four species are endemic to the Hawaiian islands. *M. villosa* is a cosmopolitan species distributed throughout the volcanic islands of the tropical Pacific "but seemingly only in the Hawaiian group associated with endemic species" (6, p. 341) where it attains its best development, forming pure stands. It is the most variable species in the Islands (18, p. 325), possessing numerous described varieties (9, p. 127) ranging from large trees to prostrate shrubs. The fruits are dry capsules and the seeds small enough to be carried to some extent by the wind. *M. villosa* ranges from the coast up to 8,000 feet (6, p. 342), but attains its best development in the middle forest zone at elevations of 2,000 to 4,000 feet, where it is associated with *Acacia koa, Cheirodendron gaudichaudii,* and similar species.

The wood is diffuse porous, reddish-brown in color, rather soft, with or without distinct growth-rings, and straight-grained. A medium-sized zone of sapwood is present distinguished from the heartwood by its more yellowish color and by the permeability of the tracheae to alcohol.

CROSS SECTION

Gross.—The vessels are barely visible with lens or, in some specimens (lxiii:1455), visible without lens, and are mostly isolated. The lumina are closed in the heartwood, with tyloses and resinlike material, but are open and readily permeable to alcohol in the sapwood. The rays are narrower than the vessels. Fine irregular and broken tangential lines of wood-parenchyma are visible with lens.

Minute.—The vessels are mainly circular in outline; some of them as large as 0.27+ mm. in diameter. The walls are 0.003 mm. in thickness. The rays are 1-2 cells wide and filled with a resinlike material. The fibers are polygonal in outline with mostly rather thick walls and are arranged in radial rows. In some cross sections the lumina of the fibers are closed with a resinlike substance. Wood-parenchyma cells are of nearly the same diameter as the fibers and mostly in contact with the vessels, but also extend in irregular tangential lines mostly from the radial sides of the vessels.

RADIAL SECTION

Minute.—The vessels consist of long segments with simple perforations somewhat smaller than the vessel lumen. The pits are variable. Subcircular bordered pits 0.006± mm. in diameter with lenticular orifices occur in the common walls between vessels. Narrowly semibordered or simple pits, varying from circular to long elliptical in outline and 0.021± mm. in diameter, occur between vessels and wood-parenchyma or ray-parenchyma cells. Very few scalariform pits occur. The lumina become closed, in the heartwood, with tyloses and resinlike contents. The rays are composed of three shapes of cells: (1) very low radially elongated cells present in the multiseriate portions of the rays; (2) nearly square cells present in the uniseriate portion of rays; and (3) axially elongated cells at the margins. The pits are 0.003± mm. in diameter between ray-cells, or between ray-cells and adjacent wood-parenchyma, and 0.021± mm. in diameter between ray-cells and adjacent vessels. The cell cavities contain a resinlike mass which collects upon the walls and obscures the pitting except in favorable sections. Uniseriate, circular-bordered pits with narrowly lenticular orifices are present in the radial walls of the fibers. Wood-parenchyma cells are 0.18± mm. in length.

TANGENTIAL SECTION

Gross.—The rays are very narrow and barely visible with a lens.

Minute.—The rays are narrowly elliptical in outline, acute or obtuse at the margins, uniseriate, uniseriate in part, or 2-3 seriate in composition. Cells in the multiseriate parts are subcircular; those in the uniseriate parts, axially elongated, especially at the margins. Semibordered pits are common, in sections, between rays and adjacent fibers. The fibers bear rather numerous circular bordered pits with lenticular orifices in the tangential and radial walls.

MACERATION

The fibers are long (1.8± mm.), straight, and attenuate from near the middle into long sharp ends. The vessel segments are, as a rule, somewhat oblique at the ends, commonly with a tonguelike projection of varying length from one or both ends.

DISTINGUISHING CHARACTERS

The wood is diffuse porous, reddish-brown in color, with yellowish-brown sapwood, rather soft, straight-grained, of fine even texture, resinous, and with or without growth-rings. Many of the vessels are visible without a lens, isolated, composed of long segments with simple perforations and with variable, simple, narrowly semibordered, and bordered pits in the walls. The lumina are plugged in the heartwood, with resinlike material and tyloses. The rays are 1-2+ cells wide and up to 40 cells high. The fibers are long, straight, fairly thick-walled, and bear bordered pits in radial and tangential walls. Wood-parenchyma is mostly in contact with vessels but extends in indefinite broken tangential lines.

Order UMBELLIFLORAE

Family ARALIACEAE

A family of 51 genera largely of tropical distribution. Most of the species are trees, shrubs, and climbers; a few are herbs. Familiar American representatives of this family are the Hercules club, *Aralia spinosa,* and herbaceous species of Aralia including ginsing.

The wood is characterized by vessels with simple or scalariform perforations, by broad medullary rays, and by the occurrence of secretory canals (17) in the rays in some of the genera. The wood-prosenchyma is characterized by simple pits.

Tetraplasandra waimeae Wawra. OHE KIKOOLA.

Material, xxxvii:41:1426.

The genus Tetraplasandra consists of about 12 species, all but two species of which are endemic. *Tetraplasandra waimeae* is a medium-sized tree, 30-40 feet high, and 12+ inches D. B. H. The species is endemic to the island of Kauai, at 3,600 feet. It is rather xerophytic and occurs in association with *Cryptocaria mannii, Bobea mannii, Sideroxylon sandwicense,* and *Elaeocarpus bifidus.*

The wood is nonresinous, yellowish-white, with silvery luster, and with little difference in color of heartwood, of medium hardness, even texture, straight-grained, and without growth-rings.

CROSS SECTION

Gross.—The vessels are not visible without lens, diffuse, generally in small radial groups, without tyloses, slightly smaller than the rays; rays, visible without lens, and light-colored.

Minute.—The vessels are small, rather uniform in size, 0.1± mm. in diameter, or, exceptionally, 0.15 mm., grouped mostly 2-3 radially together, occasionally 3-9+, have slightly thickened walls (0.006 mm.), are radially perforate (cf. fig. 7, *a*), and have few tyloses. The rays are 1-3+ cells wide, and straight; the cells, very thin-walled (0.001 mm.), empty, with numerous, generally circular pits 0.001-0.006 mm. in diameter. The prosenchyma cells are polygonal in outline, thick-walled (0.006± mm.), with wide lumina, arranged in regular radial rows and with numerous simple pits in the radial walls. The wood-parenchyma is paratracheal, 1 cell deep, incompletely surrounding the vessels.

RADIAL SECTION

Gross.—The rays are conspicuous, slightly dark-colored, 1± mm. high, and visibly heterogeneous under a lens. The vessels are visible under lens; a few have dark contents.

Minute.—The vessels have bordered or semibordered or simple pits circular to long elliptical in outline. The perforations are simple, terminal and lateral in position (fig. 8, *c*). The lateral perforations are many, occur on the radial walls, and are commonly single instead of double as in Cheirodendron (fig. 7, *b*). The rays are heterogeneous, with marginal cells 0.06± mm. in radial diameter and 0.1± mm. in height. The central portion of the ray consists of radially elongated cells 0.15± mm. long and 0.02± mm. high. The radial walls bear numerous circular or elliptical pits variable in size when adjacent to parenchyma, and relatively larger, variable, elliptical, semibordered or simple pits when in contact with vessels. The prosenchyma cells are numerously and conspicuously marked with simple pits with narrowly lenticular, vertical orifices. Wood-parenchyma cells elongated (0.21± mm.) in contact with vessels.

TANGENTIAL SECTION

Gross.—Rays are barely visible without lens, showing as fine lines of variable length up to 2+ mm. The vessels are difficult to distinguish, except those having dark contents.

The vessels bear elliptical or scalariform pits and are composed of long segments 1 mm., oblique at the terminal plane of perforation. The rays are 1-3+ seriate and from 1 cell to 70+ cells high; the uniseriate rays are homogeneous; the wider rays, imperfectly heterogeneous. The cells are very thin-walled and many break down in sectioning. Those in the wide rays are irregular in shape and size, but many, with the smaller less elongated cells, are surrounded on all sides by a layer more or less elongated axially. Most of the marginal cells are 2-4 times as high as wide. The uniseriate ray-cells are elongated axially. The fibers have few pits on the tangential walls.

MACERATION

The vessel segments are long and cylindrical with oblique ends, many of which have a tonguelike projection from one end or both ends. The pit markings are generally elliptical in outline with lenticular or slitlike orifices. The perforations are simple, and both terminal and lateral in position. Prosenchyma fibers are usually less than 1.3+ mm. in length, prismatic in shape, with abundant pit markings on the radial walls and short irregularly tapering and sometimes unpitted points.

DISTINGUISHING CHARACTERS

The wood is yellowish-white in color, of medium hardness, even textured, without growth-rings, straight-grained. The vessels are diffuse, arranged in small groups, smaller than the rays, have few or no tyloses, medium thin-walled, with elliptical bordered, semibordered, or simple pits, long segments, oblique ends, and simple perforations both terminal and lateral in position. Rays 1-3 seriate, up to 2+ mm. in height, imperfectly heterogeneous where more than one cell wide, and very thin-walled. The fibers are prismatic, nonseptate, with short tapering ends, of medium length, and rather thick-walled with open lumina, and conspicuously pitted on the radial walls. Wood-parenchyma cells are few and mostly in contact with the vessels.

Dipanax gymnocarpa A. A. Heller.

Pterotropia gymnocarpa Hbd.

Material, xxxviii:18:1427.

This genus is endemic to the Territory and consists of the three following arborescent species: *Pterotropia gymnocarpa, P. dipyrena,* and *P. kauaiensis. Pterotropia gymnocarpa* occurs in the rain forests at elevations of 2,000 feet or more, "associated with *Pelea sandwicensis, Euphorbia rockii, Hibiscus arnottianus, Syzygium sandwicense,* and *Elaeocarpus bifidus*" (18, p. 355). It is smaller, growing only 15-30 feet in height.

The wood is pale yellow in color with high luster, with a medium-wide zone of sapwood, which in seasoning may turn bluish.

The wood is soft, even textured, and straight-grained. The pith is large, circular, 1± cm. in diameter.

CROSS SECTION

Gross.—Growth-rings are defined by deep-colored latewood. The vessels and rays are scarcely visible without lens; the vessels are diffuse, rather uniform in size, grouped 2± together and slightly larger than the rays The rays are straight and light-colored.

Minute.—Growth-rings are defined mainly by the tangential compression of the fibers. The vessels occur in small groups, or isolated, are subcircular in outline, unless compressed by aggregation, of rather uniform size, and generally less than 13+ mm. in diameter with open lumina. Lateral perforations are common. The rays are straight, 1-4+ seriate, composed of short cells, with thin walls (0.002 mm.); cavities, without resin or crystals; walls, numerously pitted with subcircular to elliptical pits, irregularly in radial rows, and varying from fine to coarse (0.001-0.009+ mm.) in diameter. The fibers are in radial rows, rounded polygonal in outline, or tangentially compressed at the termination of a growth-ring. The walls are thin (0.003± mm.) with simple pits, most numerous on the radial walls; lumina, large except in latewood, commonly equal to eight-tenths the diameter of the fiber. Wood-parenchyma is not abundant, occurring as isolated cells mainly in contact with the vessels; the walls, thin; cavities, without resin or mineral crystals.

RADIAL SECTION

Gross.—The surface is light yellow in color and of uniform texture, and high luster. The rays are straight and fine but plainly visible without lens. The vessels are visible under a lens. Growth-rings are faint.

Minute.—The vessels are straight, composed of long segments with large simple perforations (cf. fig. 7, *b*, *p2*); pits, scalariform or large elliptical or circular bordered, with lenticular crossed orifices; perforations, commonly terminal, with abutting ends of segments turned inward (cf. fig. 7, *c*). As a rule the segments of a group are conterminous. The rays are composed of rather large thin-walled (0.002 mm.) cells not greatly elongated. Those in the central portion are generally slightly longer radially; those at the margin, slightly elongated axially. The radial walls are minutely pitted in contact with prosenchyma, or coarsely pitted in contact with parenchyma, or with large elliptical to scalariform semibordered or simple pits in contact with vessels. Many of the fibers are conterminous, having numerous simple pits with slitlike orifices in irregular axial rows. Wood-parenchyma is not abundant and bears large elliptical semibordered or simple pits communicating with the vessels; cavities, as a rule, are empty.

TANGENTIAL SECTION

Gross.—The tangential surface is of uniform texture and yellow or bluish in color, with no structural differences visible without lens. Under lens the rays are slightly darker than the surrounding tissues, and appear with narrow linear lanceolate, acutely pointed outlines. The vessels, on account of their light color and small size, are difficult to distinguish.

Minute.—The vessels show scalariform or crowded variously bordered pits with lenticular orifices, or, less commonly, coarse elliptical semibordered or simple pits in contact with parenchyma. Walls in contact with fibers are minutely pitted. The rays are linear or linear-lanceolate in outline, and acutely pointed at the margins. The cells are irregular in size, vary from 0.015 to 0.12 mm. in diameter, and generally have elongated cells at the margin. The fibers are sparsely pitted on the tangential walls.

MACERATION

The vessel segments have simple terminal (fig. 7, *c*) or lateral perforations as in figure 7, *b*, *p2*. In some segments each end extends into an overlapping tip (fig. 7, *d*). The length varies from 0.2 to 1 mm. The pit markings vary from lenticular to scalariform or open elliptical. The fibers are serried radially, and rounded prismatic in shape with short and irregular attenuate unpitted points, and from 0.7 to 1.3 mm. in length. The radial sides are numerously marked with slitlike slightly oblique pit orifices. Ray-cells are tabular, and generally numerously pitted with subcircular or broadly elliptical pits of varying sizes. Also cells occur with characteristic vessel- or prosenchyma-contact pits. The few wood-parenchyma cells are elongated and generally show scalariform markings.

DISTINGUISHING CHARACTERS

The wood is diffuse porous, soft, pale yellow with high luster, faint growth-rings, and bluish sapwood, of even texture and straight-grained. The vessels are arranged mainly in small groups, are visible with a lens, have simple perforations, terminal and lateral in position, are bordered, semibordered, or have simple variable pits that are sometimes seen in scalariform arrangement. There are a few scalariform perforations. The rays are 1-4 cells wide and commonly less than 1.5 mm. high. Simple or semibordered pits are formed in contact with vessels. The fibers have thin walls with numerous simple pits. Wood-parenchyma cells are few and mostly in contact with vessels.

Panax gaudichaudii DC. OLAPA.

Cheirodendron gaudichaudii (D. C.) Seem.

Material, xxxix:28:1429.

The species attains a height of 40-50 feet and a diameter of 24 inches. It is common throughout Hawaii in the middle forest zone at elevations of 2,000-4,000 feet. The wood is light straw-yellow, diffuse porous, of medium hardness, without growth-rings, and without distinct heartwood.

CROSS SECTION

Gross.—The vessels are visible with lens, of rather uniform diameter, larger than the rays, many of them grouped in twos, and there are few tyloses. The rays are plainly visible without lens.

Minute.—The vessels are of rather uniform diameter (0.08± mm.) and subcircular in outline or flattened by contact, grouped in twos for the most part, or, less commonly in threes or fours+; a few, usually of large diameter, occur singly; walls, thin (0.003 mm.). Many partition walls, especially of the radial sides, are open in the middle on account of the presence of large lateral perforations (cf. fig. 7, *a* and *b*). Cavities are empty or have tyloses. The vessels are in contact with prosenchyma except where adjacent to rays or occasional wood-parenchyma cells. The rays are straight, from 1-4+ cells broad, thin-walled, numerously and conspicuously pitted on walls, and communicate with adjacent prosenchyma by simple pits. The cells in the broad rays are elongated (0.24± mm.) or short (0.06 mm.) in the uniseriate rays. The fibers are in rather regular radial rows, thick-walled (0.006± mm.), and under high power are seen to be pitted conspicuously on radial and sometimes on tangential walls with simple pits. Lumina, large open; pectin lamella often found thickened at the angles. There are a few wood-parenchyma cells, generally in contact with vessels.

RADIAL SECTION

Gross.—The surface is of high luster, very uniform in texture and color; the rays are conspicuous, light-colored; the vessels not visible except under lens.

Minute.—The vessels are straight, with scalariform-bordered pits in mutual contact or with elliptical or scalariform semibordered or simple pits in contact with ray- or wood-parenchyma. Walls in contact with fibers bear few small subcircular or elliptical semibordered pits with lenticular orifices; segments, long (1.3± mm.); perforations, highly variable from scalariform with few bars, to reticulate or simple with one or more large circular or elliptical openings, with the plane of perforation obliquely inclined toward the rays. The rays are heterogeneous with vertically elongated marginal cells, very thin-walled (0.002 mm.), nonresinous, and numerously pitted on all walls except those in contact with fibers, where the pits are few, simple, and minute. Those communicating between ray-cells are small (0.003 mm. in diameter), subcircular in outline, and tend to occur in radial rows. Pits communicating with vessels are generally scalariform or long elliptical and semibordered. The fibers bear numerous scattered simple pits with axially inclined slitlike orifices. Many terminate at the ray margins, with rounded ends. Wood-parenchyma is nearly absent, and mostly in contact with vessels that have semibordered or simple scalariform pits extending from one side to the other transversely across the wall in contact with the vessels.

TANGENTIAL SECTION

Gross.—The rays and vessels are visible with a lens, the surface appearing of very uniform texture and color. Under lens the rays appear of slightly darker color, short, and about as wide as the vessel cavities. The vessels are straight, without tyloses or resin, and of the same color as the fibers.

Minute.—The rays are elliptical in outline, 1-4+ cells wide and mostly less than 1 mm. in height. From one to three secretory canals are present in some of the rays. Such canals are broadly elliptical in outline (fig. 9, *c*) and 0.07± mm. in diameter. An inner somewhat irregular layer of small cells (*l p s*) lines the cavity. The occurrence of intercellular canals in dicotyledonous species constitutes a character of considerable systematic value as shown for the first time by S. J. Record (17). The rays usually terminate with a single cell, though some have two or more cells of 2-3+ times the average height of those in the central portion of the ray. The fibers bear few simple pits in tangential walls.

MACERATION

The vessel segments are long (1.3± mm.), cylindrical, with obliquely truncated ends. The perforations are highly variable from scalariform to simple. The ray-cells are commonly elongated, 4-10 times as long as wide, and numerously and finely pitted; a few bear scalariform outlines, in contact with vessels; still others bear small pits in contact with prosenchyma. The relatively few marginal cells are distinguished by their tabular shape. The fibers are long (2± mm.), 0.03± mm. in diameter, and taper somewhat irregularly many with ends irregularly bent, forked, wavy margined, or less commonly, rounded and blunt. The walls are 0.006± mm. in thickness, are numerously pitted in radial rows having scattered simple pits with axially inclined slitlike orifices. Some of the fibers are resinous. Wood-parenchyma cells are rare and may be distinguished by the transverse barlike scalariform markings formed in contact with vessels.

DISTINGUISHING CHARACTERS

The wood is of medium hardness, light-yellow, without growth-rings or distinct heartwood. The vessels are diffuse, generally grouped in twos, less frequently found singly or 2-4+ together; walls, thin with scalariform pitting; cavities, with few if any tyloses and little resin; segments, long, cylindrical; perforations varying from scalariform with few bars to reticulate, or simple with one or more large circular elliptical or irregular openings. The rays are mostly multiseriate (1-4+ cells wide), heterogeneous, and many contain one or more intercellular canals. The fibers bear simple pits with slitlike orifices, mostly on the radial walls. The fibers are about 2 mm. maximum length, and irregularly taper pointed. Some have forked ends. Wood-parenchyma cells are uncommon and adjacent to vessels.

Panax platyphyllum Hook. et Arn. LAPALAPA.

Cheirodendron platyphyllum (Hook. et Arn.) Seem.

Material, xx:x4:1425.

This is an endemic species somewhat smaller than *Panax gaudichaudii,* occurring in the rain forests or on swampy ground at elevations of 4,000-6,000 feet. It is far less common than *C. gau-*

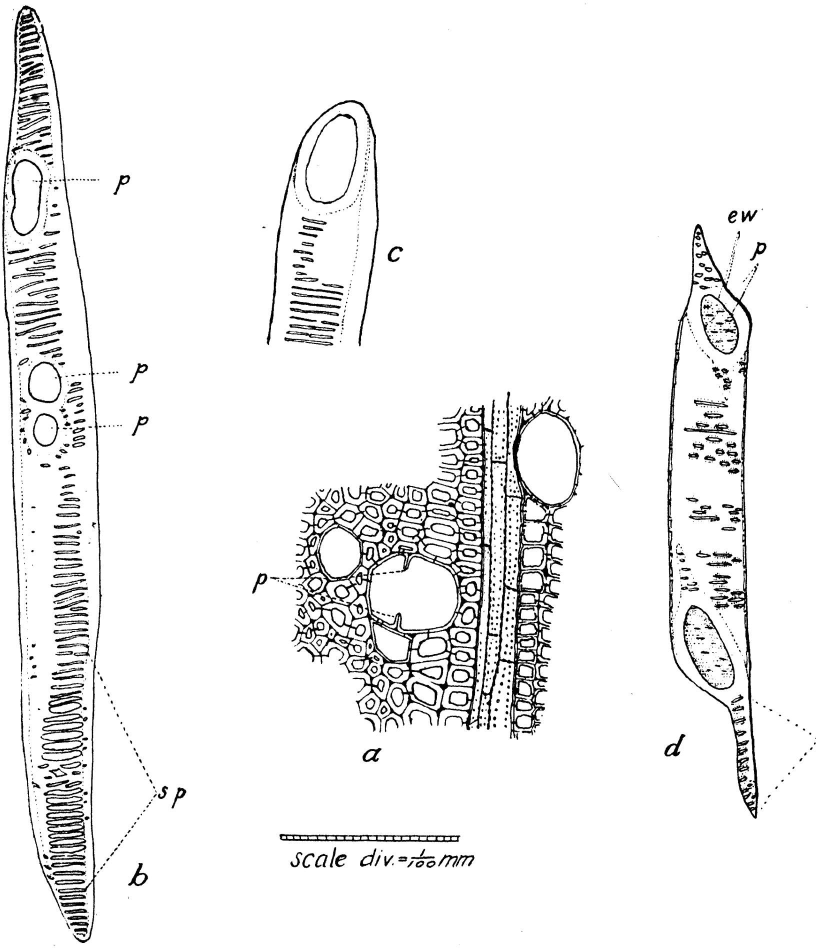

FIGURE 7. **a-c**, Sections of *Panax platphyllum* wood: **a**, cross section, showing lateral perforation (**p**); **b**, tracheal segment showing simple lateral perforations (**p**) and scalariform perforation (**sp**); **c**, tracheal segment showing terminal simple perforation; **d**, Tracheal segment of *Pterotrotopia gymnocarpa* wood showing end-wall (**ew**); perforation, simple, but smaller than the vessel-lumen (**p**); and tonguelike projection (**t**).

dichaudii, and is limited to the islands of Kauai and Oahu. It is associated with Pelea and Dubautia. The wood is pale yellow, of medium hardness, brittle, cross-grained, without growth-rings or distinct heartwood.

CROSS SECTION

Gross.—The vessels are visible with lens, smaller than the rays, diffuse, grouped 2-4 together, mostly in twos, or some single.

Minute.—The vessels are subcircular in outline, except where flattened in contact, with few tyloses; the walls are thin (0.003 mm.); many partition walls show large perforations (fig. 7, *a*), through the radial walls between adjacent tracheae. The vessels are mainly in contact with fibers. The rays are straight, mostly multiseriate, and composed of numerously pitted, narrow, greatly elongated cells; cell-walls, thin (0.002 mm.). The fibers occur in rather irregular radial arrangement, are thick-walled (0.006± mm.) with wide lumina; radial walls of the fibers bear many simple pits. The middle lamella as a rule is thickened at the angles. Wood-parenchyma walls are uncommon, and occur mostly in contact with the vessels.

RADIAL SECTION

Gross.—The color is grayish pale yellow, figured only by the slightly lighter color of the rays. The vessels are visible under lens, usually dark in color, and straight.

Minute.—The vessels have narrowly elliptical or scalariform bordered pits when in contact with vascular elements, or semibordered pits in contact with ray- or wood-parenchyma cells, or are sparingly pitted with minute pits when in contact with fibers. The perforations are highly variable, from scalariform to reticulate or simple, and occur on lateral (fig. 7, *b*) (generally radial) walls as well as on end-walls. The rays are heterogeneous, the central cells elongated radially. The marginal cells are shorter and higher, but variable, 0.03 to 0.18 mm. high axially and 0.06± mm. long radially. The walls are pitted abundantly with numerous, subcircular pits about 0.003 mm. in diameter which tend to occur in rows, or with coarse, elliptical or scalariform semibordered or simple pits in contact with the vessels. Cells which constitute the inner layer of the secretory canals (fig. 9, *b*) are variable in length and shape, with the axial walls obliquely inclined as if such cells had been pushed over in an outward direction parallel with the axis of the canal. The fibers bear irregularly arranged simple pits with slitlike orifices, either inclined with or oblique to the axis. Wood-parenchyma is not abundant, consisting of a few cells, mostly in contact with vessels, and bearing scalariform or broadly elliptical pits.

TANGENTIAL SECTION

Gross.—The dull whitish-yellow surface is very uniform in texture and color. Under lens the rays are of slightly darker shade than the prosenchyma, low, mostly less than 3 mm. high, and much broader than the vessels, which are straight and commonly darker in color than the rest of the wood.

Minute.—The vessels have scalariform (or narrowly elliptical) pits except where in contact with fibers. The segments are of medium length (1.3± mm.) and cylindrical. The rays are broad (0.006 to 0.18 mm.) and imperfectly heterogeneous, or uniseriate and homogeneous. The broad rays terminate at the margin, generally rather obtusely, and very few are more than 1.5 mm. high. Some of them contain 1 to 3 resin ducts. The cells composing all but the margins are subcircular in outline and 0.015± mm. in diameter. The marginal cell is commonly larger and irregular, though as a rule slightly elongated axially. The fibers are sparingly pitted on tangential walls with slitlike, simple pits. Wood-parenchyma is not abundant and occurs mostly in contact with vessels.

MACERATION

The vessel segments are cylindrical, 0.7 to 1.3+ mm. in length, and very variously pitted and perforated (fig. 7, *b*) on the lateral walls. Some segments show evidences of lateral fusion. Scalariform, reticulate, and large simple perforations occur in end-walls and in some of the lateral walls. Lateral walls which have been in contact with prosenchyma show few minute subcircular pit markings. Other walls show scalariform or narrowly elliptical pit markings. The ray-cells are generally elongated, 4-6 times as long as broad, with small simple pits in longitudinal rows. There are some cells with scalariform pit markings. Prosenchyma fibers are 1.5 mm. long or shorter and are numerously pitted on the radial walls, throughout the length of some of them. The points are often observed irregularly curved or bent or forked. Some of the fibers are resinous.

DISTINGUISHING CHARACTERS

Wood is distinguished from *Panax gaudichaudii* by its white color, duller luster, and more cross-grained wood. The rays, especially, are much broader than the vessels, many 10+ cells wide, or nearly twice as broad as in *P. gaudichaudii*.

Order ERICALES

Family EPACRIDACEAE

A family of shrubs or small trees confined mainly to Australia and Polynesia. There are 21 genera, all but one of which are to be found in Australia or Tasmania. The vessels have small lumina (0.03 mm.) and in many species 1-2 seriate medullary rays, the cells of which are elongated axially. The vessel walls bear bordered or semibordered pits. The perforations are simple, as a rule, but scalariform perforations occur. Spirals occur at the ends of the vessels of Epacris. The wood-parenchyma is little developed. Bordered pits occur in the walls of the prosenchyma.

Cyathodes tameiameiae Cham. PUKEAWE. Material, xxv:74:1438.

Styphelia tameiameia F. Muell.

This is the largest genus in the family, and most of the species are Australian. *Cyathodes tameiameiae* is indigenous to Hawaii, where it is of general distribution at all elevations. It also occurs in Tahiti and in the Society Islands. A height of 10-15 feet is reached by this tree and a D. B. H. of 12 inches.

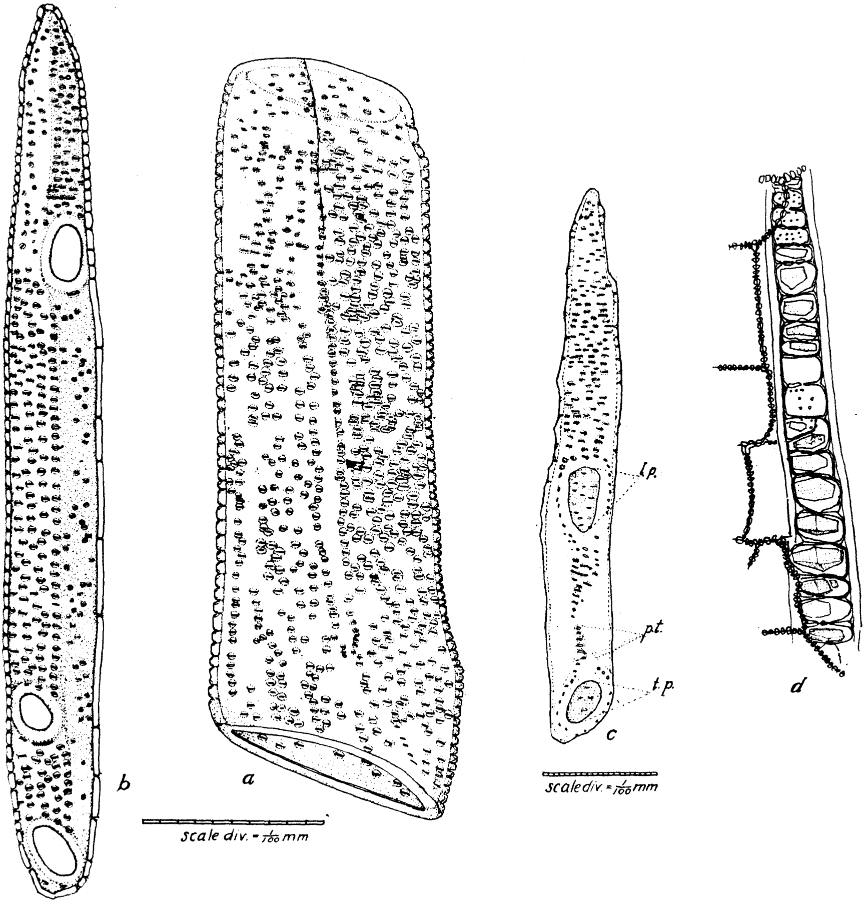

FIGURE 8. **a** and **b**, Sections of *Dubautia plantaginea* wood: **a**, tracheal segment, truncate, and with simple terminal perforations, of nearly the size of the vessel lumen; **b**, tracheal segment with lateral perforations; **c**, tracheal segment of *Tetraplasandra waimeae* wood, showing lateral perforation (**lp**); terminal perforation, smaller than the vessel lumen (**tp**); markings of overlapping tonguelike projection of the sequent vessel segment, now removed (**pt**); **d**, crystal-parenchyma of *Cyathodes tameiameiae* wood, showing octahedral crystals.

The seasoned wood is deep reddish-brown in color with medium wide zones of light reddish-brown sapwood, resinous, of medium hardness, even and fine textured, slightly cross-grained, and with a very slight indication of growth-rings.

CROSS SECTION

Gross.—The rays are visible with lens and reddish in color. The vessels are diffuse, isolated, much smaller than the rays, and visible only under a lens.

Minute.—Most of the vessels are isolated, but a few are in contact. They are very small, 0.06± mm. in diameter, thin-walled (0.002 mm.), without tyloses, but some contain a resinlike body. The rays are 1-8 cells wide, broader than the vessels, straight, mostly short-celled; the cell cavities are filled with large globules that stain deeply with safranin. The fibers are irregularly polygonal in outline, very variable in size (0.03± mm.), with medium thick walls, pitted on all sides, and large rounded lumina. There is no definite arrangement. Growth-rings are indistinctly indicated by a slight flattening of the prosenchyma cells. Wood-parenchyma cells occur in numerous single-celled broken tangential rows. The cells have deep-staining contents similar to the rays. Crystal-parenchyma is present and as a rule is in contact with or within the rays.

RADIAL SECTION

Gross.—The rays are reddish but not conspicuous, and some of them are 2 mm. high. The vessels, visible under a lens, are very small, numerous, straight, and empty.

Minute.—The vessels are straight, with medium-long segments, and sides with few minute (0.003 mm.) circular-bordered pits; perforations, simple, obliquely inclined, and terminal or lateral in position. The rays are composed of cells some of which are elongated axially and some radially. The radially elongated cells occur within (as determined from the tangential section); the axially elongated cells tend to occur at the margin and the outer portion of the radial sides. The cell cavities are filled with globules which stain deeply with safranin. The walls are thin (0.003 mm.), numerously and finely pitted on the upper, lower, and tangential walls. The radial walls are numerously pitted with small subcircular pits 0.003± mm. in diameter, and are of nearly the same size even in contact with vessels. Such pits are commonly obscured by staining, but clear in glycerine. The prosenchyma is nonseptate with numerous circular-bordered pits on all walls similar to those in the vessels. Wood-parenchyma consists mostly of axially elongated finely pitted cells with globular contents which stain deeply with safranin. Crystal-parenchyma is present in places, often observed in association with the rays (fig. 8, *d*). The crystals are solitary, octahedral, and dissolve without effervescence in 10 per cent HCl.

TANGENTIAL SECTION

Gross.—Structural details are scarcely visible without lens. Under lens the rays appear as reddish lines that are often observed as long as 2 mm. The vessels are smaller than the rays and difficult to distinguish.

Minute.—The vessels are numerous, fine, straight, sparingly and minutely pitted. The rays are from 1-6+ cells wide, and from 1-70 cells high, with cells filled with a resinlike substance. The cells in the broad rays are variable in shape, outline, and arrangement, but those with greatest

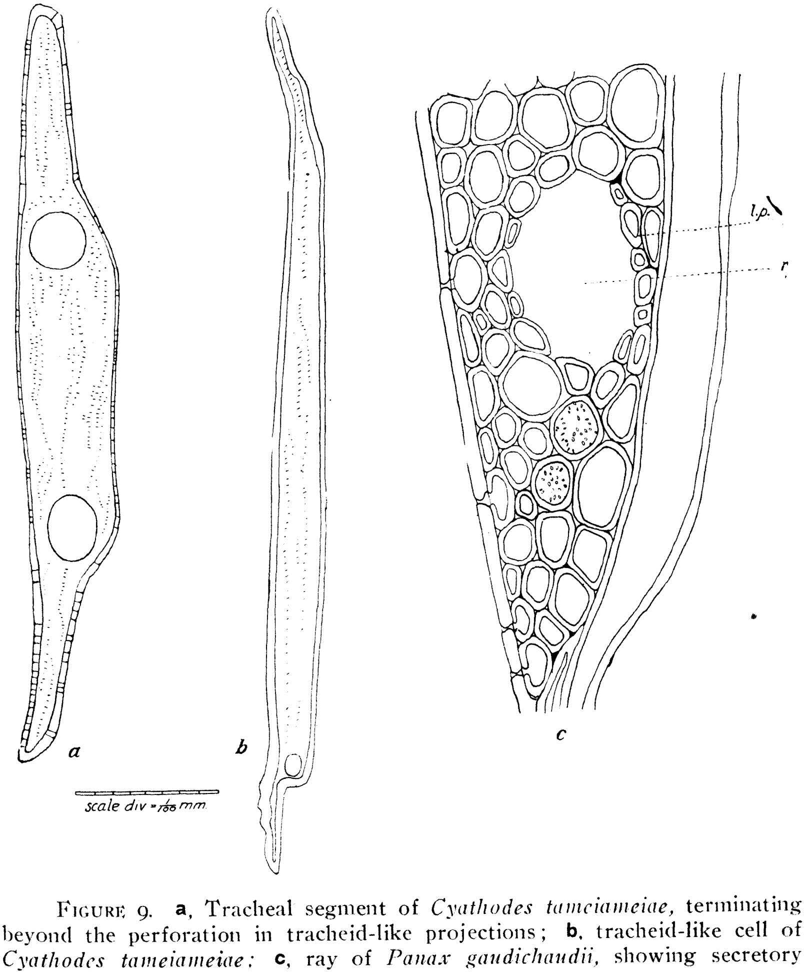

FIGURE 9. **a**, Tracheal segment of *Cyathodes tameiameiae,* terminating beyond the perforation in tracheid-like projections; **b**, tracheid-like cell of *Cyathodes tameiameiae;* **c**, ray of *Panax gaudichaudii,* showing secretory canal (**r**) and inner layer of small, pitted cells (**lp**).

axial elongation tend to occur at the margins or sides. Aggregations of rays occur.

MACERATION

The vessel segments are cylindrical, of medium length (0.4± mm.), with simple perforations oblique as a rule and many near the end and lateral (fig. 9, *a*). A projecting tip of varying length is usually present at one end or both ends. The pit markings are minute, few, and resemble the pitting of prosenchyma. Intermediate forms between prosenchyma and tracheal elements are numerous (fig. 9, *b*). The prosenchyma is made up of fibro-tracheids with numerous bordered pits. The ends taper irregularly for about one-third the length of the fibro-tracheid. The pitting generally extends over the sides of the tapering portion. The walls are of medium thickness.

DISTINGUISHING CHARACTERS

The seasoned wood is deep reddish-brown with lighter colored sapwood, resinous, of medium hardness, even and fine textured without distinct growth-rings. The vessels are visible with a lens, numerous, isolated, without tyloses, minutely and sparingly pitted, and with simple perforations terminal, some lateral in position. The rays are 1-6 cells broad, and up to 2+ mm. in height, very resinous, and irregularly heterogeneous. The pits are small and are little if any larger where in contact with a vessel. The prosenchyma is composed of fibro-tracheids 1± mm. in length and pitted throughout with small bordered pits having long oblique slitlike orifices. Wood-parenchyma is metatracheal, resiniferous, and distributed in numerous broken lines 1 cell in width. Crystal-parenchyma is present but not abundant.

Family MYRSINACEAE

The Myrsinaceae are trees or shrubs of which there are about 770 species of general distribution in the Tropics. The wood is characterized by vessels with simple or scalariform perforations and by bordered, semibordered, and in some specimens simple pits. Some rays are as wide as six cells or wider. Wood-parenchyma is not abundant; the fibers bear simple pits and are commonly septate.

Myrsine lessertiana A. DC. KOLEA.

Suttonia lessertiana (A. DC.) Mez.

Material, xlvi:35:1447.

M. lessertiana is a variable species of the rain forests of Oahu, Hawaii, and of other islands of the group. It is endemic, attains a height of 60 feet and a D. B. H. of 24 inches. The wood is pinkish-yellow in color, resinous, with coarse reddish-brown rays, diffuse porous, rather hard, cross-grained, and without growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with lens, isolated or in radial groups of twos, or rarely more, and circular in outline, or slightly compressed in contact. The lumina are mostly free from contents and permeable to alcohol. The rays are very broad (0.4± mm.), with brownish resinlike contents.

Minute.—The vessels are nearly uniform in size and mostly less than 0.1 mm. in diameter. Occasionally lumina filled with a resinlike body are seen. The walls are 0.003 mm. in thickness. The rays are multiseriate, over twice as wide as the vessels, and composed of cells not greatly elongated. The cell cavities are filled with globular, resinlike material. The fibers are polygonal, of rather large diameter, medium-thick walls, and contain resinlike material in the lumina. Simple pits are present in all walls. Wood-parenchyma cells occur mainly adjacent to vessels, and contain resinlike material.

RADIAL SECTION

Gross.—The rays are very prominent and reddish in color.

Minute.—The vessels are composed of segments of medium length, with simple, circular or elliptical perforations smaller than the vessel lumen; the pits are semibordered or bordered, small, numerous, and with variable long or short lenticular or slitlike orifices. The rays are composed of (1) a few radially elongated cells, (2) many nearly square cells, and (3) a number of axially elongated cells, especially at the margins, many of which show transition to fiberlike shapes. The ray pits are minute. Wood-parenchyma cells are 0.12± mm. in length.

TANGENTIAL SECTION

Gross.—The rays are prominent and some of them as much as 9+ mm. in height.

Minute.—The longest rays are as much as 200+ cells high and 15+ cells wide. The cells are mostly broadly elliptical in outline, rather variable in size, with axially elongated cells at the margin or sides. Solitary mineral crystals occur in some of the cells. The fibers are septate.

MACERATION

The fibers are short, 0.9± mm. in length, and have short irregularly tapering or forked ends. Pits are numerous and have oblique orifices.

DISTINGUISHING CHARACTERS

The wood is pinkish-yellow in color, resinous, diffuse porous, rather hard, and without growth-rings. The vessels are small, visible in cross section with lens, isolated or in small groups, finely pitted, and with simple perforations; the lumina are generally open and permeable to alcohol. The rays are very broad, the longest as much as 0.9+ mm. in height, reddish in color, and very prominent on the radial surface. The fibers are short and rather thcik-walled. Wood-parenchyma cells are mostly in contact with vessels.

Order EBENALES
Family SAPOTACEAE

The Sapotaceae are trees or shrubs of general distribution in the Tropics and comprise about 445 species. The wood is characterized by vessels with simple or, rarely, scalariform perforations, and bordered, semibordered, and in connection with the rays, simple pits. The rays are narrow, 1-6 seriate. Wood-parenchyma occurs in tangential lines. Wood-prosenchyma is thick-walled with small lumina and bears simple pits.

Sideroxylon sandwicense (Gray) Benth. and Hook. ALAA.

Material, cii:33:1477.

The genus Sideroxylon comprises over 100 species. Those occurring in Hawaii are mainly xerophytic, and characteristic especially of the leeward sides of the islands. *S. sandwicense* grows to a height of 50 feet and occurs as an endemic species generally throughout the Territory except in the island of Hawaii, where the species is absent. The wood is yellow, streaked with black, hard, straight-grained, diffuse porous, and with faint growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, and mostly grouped many together, in radio-tangential series. The lumina are mostly open and permeable to alcohol. The rays are smaller than the pores, visible but not prominent under a lens. Numerous fine tangential lines of wood-parenchyma are visible with a lens.

Minute.—The vessels rarely exceed 0.12 mm. in diameter; the walls are rather thin (0.003 mm.). The rays are 1-2+ cells wide; the cells, mostly elongated and minutely pitted. The fibers have thick walls, small lumina, and small simple pits. Wood-parenchyma cells are of nearly the same diameter as the fibers, but have thin walls, are numerous and arranged irregularly in tangential rows. Growth-rings are defined by the relative abundance of wood-parenchyma and fibers.

RADIAL SECTION

Gross.—The rays and wood-parenchyma are visible but not prominent under a lens.

Minute.—The vessels bear simple perforations as a rule somewhat smaller than the vessel lumen. The pits are bordered with lenticular orifices between adjacent vessels, and large, narrowly semibordered, or simple between vessels and ray-cells or wood-parenchyma. The rays are composed partly of radially elongated cells, partly of nearly square cells, and in small part, of axially elongated cells. Large simple or narrowly semibordered pits occur where adjacent to vessels. Wood-parenchyma cells are 0.09± mm. long, and in numerous, mainly single, rows; the pits are small or minute.

TANGENTIAL SECTION

Gross.—Wood-parenchyma and rays are barely distinguishable even under a lens.

Minute.—The rays are mainly uniseriate or uniseriate in part with one or more biseriate portions. In the uniseriate portions the cells are axially elongated, especially at the margins. In the biseriate portions the cells are much smaller with little or no elongation.

MACERATION

The vessel segments are long in proportion to diameter; the pit markings, mainly small; but there are many large elliptical or irregular simple pits. The perforations are generally smaller than the vessel lumen. Many of the vessels project beyond the perforations into short tonguelike ends. The fibers are mainly under 1.4 mm. in length, straight, and taper from near the middle into sharp points.

DISTINGUISHING CHARACTERS

The wood is yellow, diffuse porous, hard, straight-grained with growth-rings. The vessels are visible with a lens, grouped in large radio-tangential series. The perforations are simple and the pits bordered, semibordered, and simple. The rays are 1-2 cells wide and up to 40 cells high. The fibers are thick-walled, with small lumina, and bear simple pits. Wood-parenchyma is abundant and arranged in tangential rows.

Family EBENACEAE

The Ebenaceae are mainly tropical or subtropical plants and numerous, especially in the East Indies and Malayan Archipelago. Maba is the only genus of this family occurring in Hawaii, and only *Maba hillebrandii* Seem. is endemic, *M. sandwicensis* occurring also in Fiji.

The secondary wood is characterized by 1-2+ seriate rays, vessels with simple perforations, bordered or semibordered pits, abundant wood-parenchyma distributed both in tangential lines, sometimes found only 1 cell in breadth, and around the vessels. Crystal-parenchyma may occur. The wood-prosenchyma is characterized by bordered pits with slitlike orifices often extending beyond the border. Some members have deep-colored heartwood.

Maba sandwicensis A. DC. LAMA. Material, xxiv:22:1432.

Maba sandwicensis is a tree of 20-40 feet in height and 12 inches D. B. H. It is of general distribution in dry or rarely in wet situations in the Territory, and there are many forests of pure growth. It occurs (2) in association with *Aleurites moluccana, Pittosporum hosmeri* var. *longifolia, Antidesma pulvinatum,* or with Straussia, and Metrosideros.

The seasoned wood is hard, even textured and gritty, light reddish-brown with portions yellowish and faintly tinged with red. It was formerly used for sacred purposes.

CROSS SECTION

Gross.—There are no growth-rings. The vessels are small, visible under a lens, and in small radial groups. The rays are visible under a lens, much smaller than the vessels. Numerous, narrow, tangential, wavy lines of wood-parenchyma are visible with lens.

Minute.—The vessels are diffuse, part of them isolated and part grouped radially 2-6+ together. The walls are moderately thickened (0.006 mm.) and, when grouped, possess angular outlines. The cavities are without tyloses or other contents. Rays 1-2 cells wide, comparatively straight, with numerous small (0.002± mm.) subcircular pits. Wood-parenchyma occurs in numerous narrow tangential bands, usually 1 cell wide. Numerous isolated cells contain single mineral crystals (fig. 6, *b*). Wood-prosenchyma cells are of small diameter (0.016± mm.), thick-walled (0.006± mm.), with small lumina, and bear frequent pits.

RADIAL SECTION

Gross.—The rays are indistinctly visible without lens. The vessels are visible with a lens. The wood is straight-grained, and somewhat resinous.

Minute.—The vessels are straight, with short (0.04± mm.) segments with simple terminal perforations. The pits are small, subcircular with narrow lenticular, oblique or transverse orifices, bordered or semibordered The ray-cells are minutely pitted in contact with prosenchyma. In contact with the vessels, numerous semibordered pits are formed of nearly the same diameter as the vessel pits. The cell cavities are empty or nearly so. The uniseriate rays are composed of cells nearly square (0.03± mm.) or elongated axially (0.06± mm). The other rays are composed partly of low radially elongated cells, and partly of square or axially elongated cells similar to those in the uniseriate rays and, as a rule but not invariably, are at the margin. The prosenchyma is nonseptate but contains light-colored resin plates. The wood-parenchyma is composed partly of axially elongated cells 0.09± mm. in length, in long single cell rows alternating at regular distances with the prosenchyma, and partly of numerous crystal-parenchyma cells commonly 1 cell wide and 2-20+ in a strand.

TANGENTIAL SECTION

Gross.—The vessels are visible with lens, empty, and straight. Faint striations are produced by lines of wood-parenchyma.

Minute.—The vessels have numerous small crowded pits with faint hexagonal outlines and short lenticular transverse or somewhat obliquely inclined orifices. The rays are mainly uniseriate or uniseriate in part. The uniseriate rays are composed of axially elongated cells 0.05± mm. high, or with a slightly longer acutely pointed cell at each margin. Those that are uniseriate in part have a biseriate central portion composed of cells typically circular or broadly elliptical in outline. The uniseriate margin is composed of one to several elongated cells of the same description as in the uniseriate rays. Only a few are typically biseriate. The rays are from 1-30+ cells in height. Wood-parenchyma is without orderly arrangement.

MACERATION

The vessel segments are of rather uniform length, the pit markings small, numerous, and evenly distributed or variously grouped. The ends are commonly, but not invariably, nearly transverse and may have a short projecting tip. The prosenchyma fibers are slender, more or less wavy, thick-walled, with small lumina containing resin. The central third is pitted. The ends taper from near the middle third into long needle-like or curved points, many of them with jagged edges. The fibers are 1± mm. in length.

DISTINGUISHING CHARACTERS

The wood is light reddish-brown or whitish in portions, hard, gritty, fine and even textured, straight-grained, without growth-rings, but with many narrow concentric lines of wood-parenchyma visible with lens. The vessels are small, diffuse, commonly in small radial groups, without tyloses, medium thick-walled, with medium short segments, as a rule, but not invariably, transverse at the ends, with simple perforations, and numerous small pits with transverse or somewhat oblique lenticular orifices. The rays are 1-2 cells wide, imperfectly heterogeneous when more than one cell wide. The wood-prosenchyma is thick-walled, with small lumina transversed by resin plates, and bears bordered pits with extended slitlike orifices. Wood-parenchyma occurs in numerous tangential lines 1 cell wide; chambered crystal-parenchyma is abundant.

Order CONTORTAE

Family OLEACEAE

The Oleaceae comprise about 390 species of shrubs or trees of general distribution in the tropical and temperate climates. *Olea* *europea*, Ligustrum, and Fraxinus, belong to this family. *Osmanthus sandwicensis* is the only representative in Hawaii.

The wood is characterized by vessels with simple or, rarely, scalariform perforations, and bordered or semibordered pits. Spiral thickenings may occur. The rays are 1-4 seriate. The wood-prosenchyma has either bordered or simple pits. Septae and spirals have been found in the prosenchyma of certain genera.

Osmanthus sandwicensis Benth. and Hook. PUA or OLOPUA.

Material, lxiv:21:1463.

This species is endemic to the Territory and is one of the most common trees on the dry leeward sides in the lower forest zone. It grows to a height of 60 feet and has a D. B. H. of 3 feet. The wood is reddish- or yellowish-brown in color with dark or blackish streaks or zones. The sapwood is yellow. It is diffuse porous, very hard, with indistinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, and mostly in groups of 2-10+. The lumina in heartwood are filled with an amber-colored body and impermeable to alcohol. The rays are smaller than the vessels, light-colored, and not visible without a lens. Growth-rings are defined by zones of wood-parenchyma. (Very numerous fine tangential lines of wood-parenchyma visible with lens.)

Minute.—The vessels are mostly in irregular groups of 2-10+ each, extending in both radial and tangential directions. The size of the vessels is nearly constant throughout the growth-rings, though variable in the groups, and rarely exceeds 0.14+ mm. in diameter. The rays are 1-2 cells wide; the walls, minutely pitted. The fibers are arranged in radial rows, possess thick walls, and rather small but variable lumina, and simple pits. Wood-parenchyma is moderately abundant, of rather greater radial diameter than the fibers, and distributed mostly in tangential zones or lines, 1-2+ cells wide and at a distance of 2 to 12+ fibers apart. Also wood-parenchyma is relatively more abundant in comparatively broad zones which define the growth-rings.

RADIAL SECTION

Gross.—The elements are more or less filled with an amber-colored body. The rays and zones of wood-parenchyma are barely visible without a lens. The grain is irregular.

Minute.—The vessels are composed of segments of medium length, with simple perforations slightly smaller than the vessel lumen. The pits are small, circular in outline with short lenticular orifices in the vessel wall, uniform in size and bordered or semibordered. The rays are heterogeneous, with radially elongated cells in the central portion and generally square cells at the margin. The pits are small even in contact with vessels. Wood-parenchyma pits are minute and grouped or arranged in circles. The fibers possess simple pits with long slitlike orifices.

TANGENTIAL SECTION

Gross.—The rays are low, narrow and indistinct under a lens.

Minute.—The rays are elliptical in outline with obtuse or acute points, mostly biseriate and commonly less than 14 cells high. The cells are comparatively uniform in size, those at the margin being slightly elongated axially.

MACERATION

The fibers are of medium length, of rather small diameter, and irregularly bent or curved, tapering into irregular sharp ends.

DISTINGUISHING CHARACTERS

The wood is reddish- or yellowish-brown in color with dark streaks and yellow sapwood. It is diffuse porous, very hard, cross-grained, and with rather indistinct growth-rings. The vessels are small, visible with a lens, mostly grouped irregularly 2-10+ together, and filled with an amber-colored substance in heartwood. The perforations are simple and the pits small and uniform in size. The rays are mostly biseriate and low. The fibers are arranged in radial rows, thick-walled, with small lumina and simple pits. Wood-parenchyma is fairly abundant and in narrow tangential lines or in broader zones defining the growth-rings.

Family APOCYNACEAE

A family of mainly tropical distribution, of both woody and herbaceous forms. There are 133 genera, comprising in all 1,000 species. A few are trees, a large number are woody climbers (lianes) or shrubs, and the remainder herbaceous perennials. Three genera with arborescent species are represented in the Territory: namely, Pteralyxia, Ochrosia, and Rauwolfia. Familiar representatives are the oleander (*Nereum oleander*) and Indian hemp (Apocynum).

The secondary wood is, so far as known, characterized by narrow medullary rays, by vessels with simple perforations, and by bordered, semibordered, or, rarely, simple pits. The wood-prosenchyma has bordered or simple pits. The pith of some of the wood contains stone cells, and phloem occurs in all the sections examined, either as a continuous ring or as isolated bundles at the margin next or near to the wood.

Rauwolfia sandwicensis A. DC. HAO. Material, vii:59:1423.

Small tree, sometimes shrub, 20 feet high and 12 inches D. B. H., closely resembling Ochrosia. It attains best development in rich soil not too dry, but grows in dry situations at elevations of 2,000 feet. This is the only species of the genus represented in the Territory.

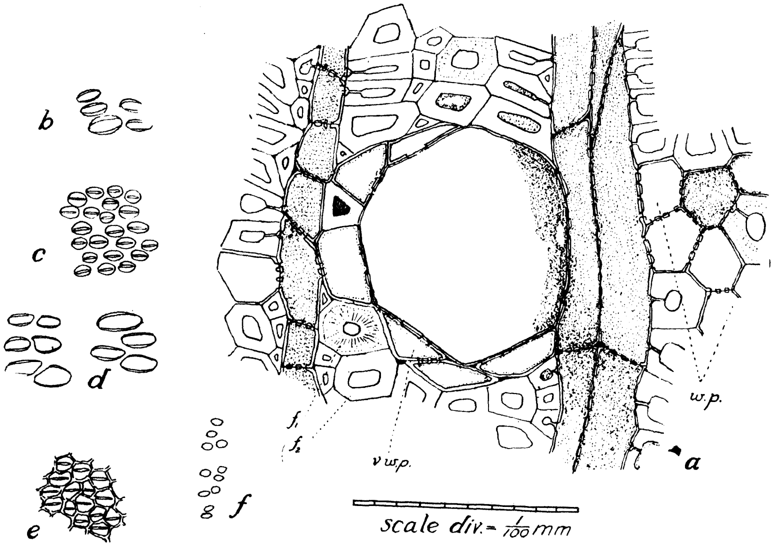

FIGURE 10. Sections of *Rauwolfia sandwicensis* wood: **a**, cross section, showing wood-parenchyma (**wp**), wood fiber, nonstriated (**fn**), wood fiber, striated (**fs**), wood-parenchyma in contact with vessel (**wpv**); **b-e**, sections showing radial pitting; **b**, semibordered pits communicating between vessels wood-parenchyma; **c**, ray-vessel pits varying from semibordered to simple; **d**, crowded bordered pits, in common wall between vessels; **e**, rounded bordered pits, in common wall between vessels; **f**, simple pits occurring in common wall between ray-cells.

The dry wood is of medium hardness and weight, fine-grained, deep reddish-brown with yellowish-brown sapwood, not greatly different from the heartwood in appearance; fairly straight-grained.

CROSS SECTION

Gross.—The vessels are diffuse, visible under lens, scattered, seldom grouped; rays, fine, scarcely visible without lens. There are no distinct growth-rings.

Minute.—The vessels are subcircular in outline, rather even in size, isolated or grouped irregularly 2-4+ together, and compressed. Diameters of more than 0.12 mm. are few. The walls are very thin (0.003 mm.) and follow the contour of the surrounding elements (fig. 10, *b*); the lumina are without tyloses, but contain a resinlike substance. The perforations are simple; segments, cylindrical and long (0.8± mm.). The rays are 1-3 cells wide, thin-walled, and contain resin which in heartwood generally fills the cavities. The wood-parenchyma is thin-walled (0.003 mm.), of about the same diameter as fibers, mainly paratracheal in distribution, and 1 cell deep (fig. 10, *a, v.w.p.*), but with somewhat irregular metatracheal grouping (fig. 10, *a, w.p.*) tangentially with the vessels; no crystals are present, but cavities of metatracheal parenchyma as a rule are filled with resin. The fibers are in regular radial arrangement, about 0.03 mm. in diameter, thick-walled (0.006 mm.), some of them thicker (0.01 mm.), and show radiating striations (fig. 10, *a, f*). Some of the cavities are filled with resin.

RADIAL SECTION

Gross.—There is little evidence of growth-rings or other differences in texture or color. Rays are curved, causing curved surfaces in splitting, but fibers comparatively straight; under lens can be seen regular alternate vertical dark and light-colored layers corresponding to prosenchyma on the one hand and vessels on the other.

Minute.—The vessels are without tyloses, have thin transparent walls, generally pitted with elliptical semibordered pits communicating with neighboring wood-parenchyma cells (fig. 10, *b*) or a somewhat larger form (fig. 10, *d*) communicating with adjacent ray-cells. Less frequently smaller but more numerous bordered pits with lenticular orifices (fig. 10, *d* or *e*) are found communicating with an adjacent vessel. The rays are distinctly heterogeneous, composed in the central portion of low, radially elongated cells 0.017 mm. high, and often over 0.09 mm. in length. The marginal cells are 0.07± mm. high and 0.036± mm. long. The walls are very thin (0.002 mm.) and numerously and finely pitted on the upper, lower, and tangential walls. The radial walls are coarsely and conspicuously pitted in contact with vessels. Pits found in contact with other elements are small and not visible except in favorable sections.

The wood-parenchyma cells are thin-walled, pitted with numerous small pits (fig. 10, *f*) wherever in contact with parenchymatous elements. As a rule the cells are elongated, 2-3 times as long as wide—some even longer; metatracheal cells are usually filled with resin. The prosenchyma cells are thick-walled, pitted sparsely with small, inconspicuous bordered pits with slitlike orifices. A few are filled with resin.

TANGENTIAL SECTION

Gross.—The texture is even with little variation in grain; luster, dull. Rays are minute and indistinct.

Minute.—Rays are commonly 3 cells wide, but range from 1-4 cells; height varies from 0.03 mm. to 1.5+ mm. The marginal portions of the rays are composed of cells which have an average height of two to several times the height of those composing the central portion, and the marginal portion of most of the rays is prolonged into a uniseriate edge, often observed as much as 5+ cells in height.

MACERATION

The vessel segments have large elliptical pit markings (fig. 6, *b-f*). The fibers are of exceptional length (2.34 mm.), thick-walled (0.006-0.009 mm.), and gradually attenuate from the middle into sharp unforked points. Wood-parenchyma cells commonly show the pit markings of figure 10, *f*, but have both larger and smaller pits according to the elements with which they have been in contact.

DISTINGUISHING CHARACTERS

The wood is diffuse porous, without growth-rings or very distinct heartwood, and reddish-brown in color. The vessels are diffuse, some grouped, very thin-walled, without tyloses, with simple perforations, and bordered pits with slitlike orifices in contact with other vessels, or large narrowly semibordered pits in contact with rays. The rays are heterogeneous, 3± cells wide and bear coarse semibordered or even simple pits in contact with vessels. Wood-parenchyma occurs in imperfect tangential lines and also about the vessels. The fibers are long, thick-walled, and bear bordered pits.

Ochrosia sandwicensis Gray. HOLEI. Material, vii:b131:1422.

Shrub or tree 10-25 feet high, and 8 inches D. B. H. It is endemic and is abundant only in dry places on the island of Maui at elevations of 2,500 feet, back of Makawao on the slopes of Haleakala, and on the lava fields of Auahi (18). The wood is grayish-yellow in color, of medium hardness, fine texture, and is straight-grained. Indistinct growth-rings are present.

CROSS SECTION

Gross.—The vessels are small and visible with, or some without, a lens, diffuse, without tyloses, and grouped radially 2-5 together or singly. The rays are visible with a lens. Growth-rings are defined by narrow reddish lines.

Minute.—The vessels vary in size but are mostly under 2 mm. in diameter. The walls are thin (0.006± mm.); the lumina are without resin or tyloses. Tracheids are often present, 0.03± mm. in diameter, and indistinguishable in this section from vessels of this diameter. The rays are usually uniseriate, rarely biseriate, coarsely and conspicuously pitted (fig. 11, *b*) on all walls, and slightly resinous. The cells are mostly 4-7 times as long as broad. The fibers are irregular in size and arrangement (fig. 11, *b*), 0.02± mm. in diameter. A narrow zone, 1-3 cells wide, of

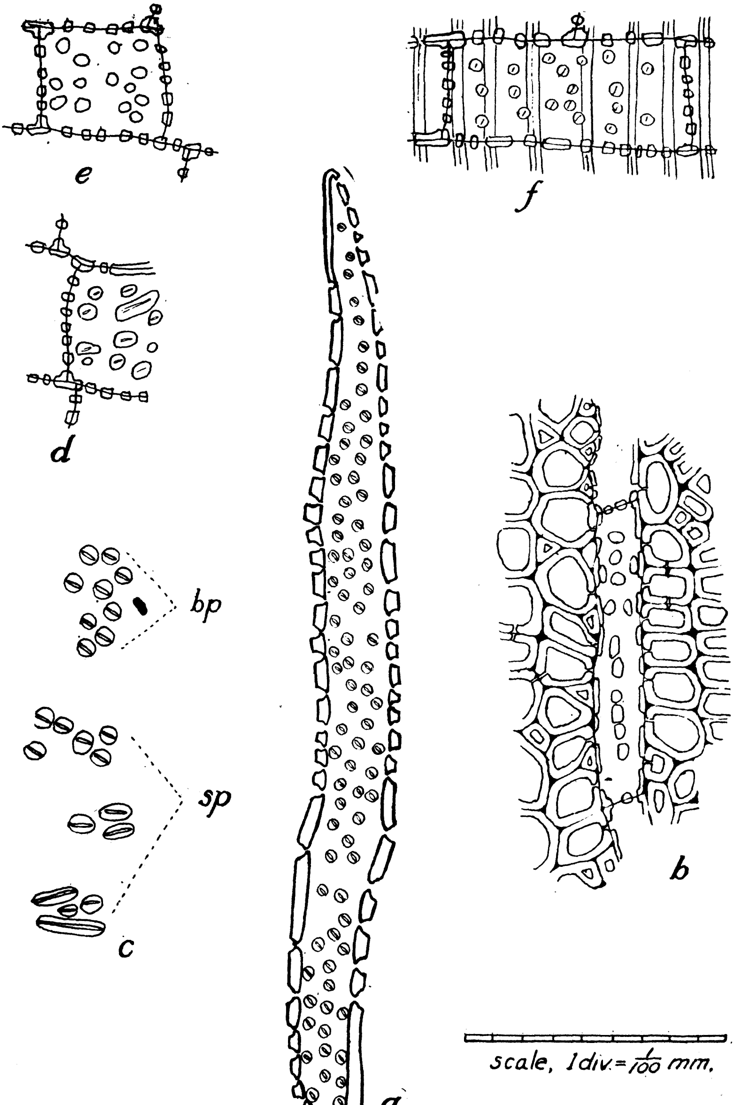

FIGURE 11. Sections of *Ochrosia sandwicensis* wood: **a**, tracheid from maceration; **b**, cross section, showing fibers and ray-cells; **c**, vessel pits, showing bordered pits (**bp**) between vessels and semibordered pits (**sp**) between vessels and ray- or wood-parenchyma; **d**, ray-pits formed in contact with vessels; **e**, ray-pits formed between parenchyma cells; **f**, ray-pits formed in contact with fibers.

compressed fibers defines the outer limit of growth-rings. The thickness of the fiber walls (0.003 mm.) varies but little. There is little, if any, other constant distinction between early- and late-wood. Wood-parenchyma is rather abundant, paratracheal and metatracheal in distribution, and thin-walled (0.002 mm. in thickness). The paratracheal cells are variously flattened in contact with vessels and adjacent elements, irregular in outline, often observed somewhat larger than the surrounding fibers, and copiously and coarsely pitted. The metatracheal cells extend in tangential lines 1 or 2 cells wide, and are generally at the beginning of a growth-ring in contact with the flattened fibers terminating the preceding ring; the cells are commonly four-sided, and equal or slightly exceed adjacent fibers in size.

RADIAL SECTION

Gross.—The wood is straight-grained, of even texture with a silky luster.

Minute.—The vessels have numerous, but not crowded, bordered pits circular in outline with narrowly lenticular, as a rule oblique, orifices when in contact with vascular elements (fig. 11, *d*) or elliptical to circular semibordered or simple pits when in contact with ray- or wood-parenchyma (fig. 11, *c*); perforations, simple; segments, many cylindrical but variable; the plane of perforation varies from transverse to somewhat oblique. The rays are imperfectly heterogeneous, composed of cells varying greatly in ratio of length to height, but typically about twice as long as high, coarsely and numerously pitted on upper and lower walls and bearing upon their radial walls three classes of pits: (a) large irregular elliptical semibordered or simple pits 0.01± mm. in length in contact with vessels (fig. 11, *d*); (b) simple pits, as a rule smaller and less elongated, when in contact with parenchyma; and (c) small circular semibordered pits in contact with prosenchyma. The fibers have numerous bordered pits with slit-like orifices and are nonseptate. The wood-parenchyma occurs mostly in continuous longitudinal strands copiously and coarsely pitted with simple pits when in contact with parenchyma, or with small semibordered pits in contact with prosenchyma, or with large irregular semibordered or simple pits in contact with vascular elements.

TANGENTIAL SECTION

Gross.—The surface is dull brownish-yellow with uniform texture. The vessels and particularly the rays are not prominent even under a lens.

Minute.—The vessels have very numerous bordered pits in contact with vessels, (fig. 11, *c*), or elongated semibordered or simple pits in contact with parenchyma. The vessel segments are somewhat irregular in shape, short, 1 to 4 times as long as broad, with the plane of perforation commonly more or less oblique. The rays are mainly uniseriate or biseriate in part, and 1-13+ cells high; the cells, widely variable but mainly 2-3 times higher than broad, and slightly resinous. The fibers have few pits in the tangential walls.

MACERATION

Some vessels have a tonguelike projection from one or both ends. Tracheids (fig. 11, *a*) are common, 0.4± mm. long, without spirals, and numerously and finely pitted. The fibers are 0.9± mm. long, and 0.02± mm. in diameter, the ends attenuate, often forked, curved and irregular, with numerous small pit markings with slitlike orifices, in the radial walls.

DISTINGUISHING CHARACTERS

The wood is of medium hardness and weight, fine-grained, yellowish, diffuse porous, with growth-rings visible without lens; no heartwood. The vessels are barely visible without lens, have no tyloses, are mostly grouped radially 2-5 together; the pits have slitlike orifices; perforations, simple; segments, short; walls, thin. Tracheids are present, 0.4± mm. long, without spirals (fig. 11, *a*). The rays are homogeneous, uniseriate or rarely biseriate; cells, all coarsely and numerously pitted on all sides. Fibers are nonseptate and often have forked ends, numerously pitted on the radial walls with small bordered pits. Wood-parenchyma occurs adjacent to or in contact with vessels, also in tangential lines or at the beginning of growth-rings.

Order TUBIFLORAE

Family SOLANACEAE

The Solanaceae are herbs, shrubs, or, rarely, trees, of temperate and tropical climates. The center of distribution is in Central and South America.

The wood is characterized by vessels with simple perforations, and bordered, semibordered, or simple pits. The perforations are simple; the rays, as a rule, narrow. The fibers bear either simple or bordered pits. Wood-parenchyma is not abundant.

Solanum sandwicense Hook. et Arn. Material, cv:xii:1474.

This species is endemic to Oahu and Kauai, grows only 4-6 feet high and is shrubby. The wood is light yellow in color with silky luster, soft, cross-grained, diffuse porous or slightly ring-porous, and with growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with lens, and for the most part grouped compactly 2-6+ together. The walls are thin; the lumina, open and very readily permeable to alcohol. The rays are much smaller than the vessels.

Minute.—The vessels vary greatly in size but rarely exceed 2 mm. in diameter. The diameter diminishes in late-wood and increases abruptly in the early-wood where the vessels are also somewhat more numerous. The rays curve irregularly around the vessels, are 1-3 cells wide and numerously pitted with small circular pits of nearly uniform size. The fibers are irregularly polygonal in outline, thin-walled, with large lumina irregularly arranged, and somewhat compressed in the final several rows of a growth-ring. Wood-parenchyma cells are few and mostly in contact with the vessels.

RADIAL SECTION

Gross.—The rays are fine but visible without lens.

Minute.—The rays are heterogeneous with radially elongated cells except at the margin where the cells are square or slightly elongated axially. The pits in contact with the vessels vary from semibordered to simple, and circular in outline, and 0.009± mm. in diameter. The fibers bear few small circular-bordered pits with short lenticular orifices in the radial walls.

TANGENTIAL SECTION

Gross.—The vessels are rather prominent on the tangential surface, and easily visible without a lens. The rays are small and visible with a lens.

Minute.—The rays are linear, elliptical in outline with acutely pointed ends. The width varies from 1 to 3 cells; the height, from 1 to 22+ cells. The cells are of nearly uniform size or elongated at the margin.

MACERATION

The vessel segments are of medium length, with simple perforations nearly the size of the vessel lumen. The pit markings are rather coarse, uniform in size, with large, elongated, lenticular orifices. A few simple pits are present. The fibers are of medium length and taper with some irregularity into long attenuate ends.

DISTINGUISHING CHARACTERS

The wood is light-yellow with a silky luster, soft, cross-grained, diffuse porous or slightly ring-porous, and with growth-rings. The vessels are small, visible with lens, mostly in small compact groups, and bear large simple perforations. The vessel pits are rather coarse, uniform in size, with long lenticular orifices, and bordered except in contact with the rays where the pits vary from semibordered to simple. The rays are heterogeneous, 1-3 cells wide and up to 22+ cells high. The fibers are irregularly arranged, have rather thin walls, large lumina, and a few circular-bordered pits. Wood-parenchyma is limited to a few cells mostly in contact with the vessels.

β var. Hbd. is distinguished from the species by the broader higher rays, smaller and more commonly isolated vessels, and the shorter more irregular fibers.

Family MYOPORACEAE

The Myoporaceae, comprising over 100 species, are chiefly confined to Australia. The wood is characterized by vessels with simple perforations and with semibordered pits in contact with ray- or wood-parenchyma. The rays are narrow; wood-parenchyma not abundant. Simple pits occur in the wood-prosenchyma.

Myoporum sandwicense (D. C.) A. Gray. NAIO.

Material, xlviii:41:1449.

Myoporum sandwicense is an endemic species occurring on the leeward sides of the islands, from sea level to 10,000 feet. At 2,500 feet the tree reaches a height of 50-60 feet and a D. B. H. of 3 feet. It grows, according to Rock (18, p. 427), at the higher levels, in association with *Sophora chrysophylla*, Raillardia, and Styphelia, or, at lower levels, with *Xylosma hawaiiense*, Ochrosia, *Dodonaea viscosa*, *Colubrina oppositifolia*, and *Mesoneurum kauaiense*.

The wood has a spicy odor, is yellowish-brown in color, diffuse porous, hard, with a waxy luster, indistinct growth-rings, and a resinlike substance in the rays and other elements. It is used as a substitute for sandalwood.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, few, and mostly arranged in small radial groups of 2-3 cells. Tyloses and an amber-colored body plug the vessels and render the wood impermeable to alcohol. The rays are yellowish and smaller than the vessels.

Minute.—The vessels are variable in size but mostly under 0.12 mm. in diameter. The rays are 1-3 cells wide and contain a deep-staining body obscuring the pits, which are circular, fairly numerous, and 0.003± mm. in diameter, and best observed in maceration. The fibers are rounded polygonal in outline, arranged in radial rows, have rather thick walls and medium-sized or small lumina, many of which are filled with deep-staining globular resinlike contents. Wood-parenchyma is not abundant and mostly in contact with vessels.

RADIAL SECTION

Gross.—The rays are small, deep yellow in color, and distinct.

Minute.—The vessels consist of rather short segments with simple perforations and small bordered or semibordered pits of uniform size with lenticular orifices. Tyloses and resinlike material are abundant in the lumina. The rays are composed of radially elongated cells in the broader portions, and of nearly square cells in the narrower portions, and in the uniseriate rays. Axially elongated cells are infrequently observed, but some occur at the margin. Small semibordered pits are formed in contact with the vessels. The fibers bear small simple pits with slitlike oblique orifices.

TANGENTIAL SECTION

Gross.—The wood is of fine, uniform texture. The rays are small and barely visible with a lens.

Minute.—The rays are of two kinds: (1) elliptical, acutely or obtusely pointed, bi- or tri-seriate rays, 2-3 cells wide and up to 20 cells high; (2) uniseriate rays, 1-3+ cells high. The cells in the wide rays are of nearly uniform size or slightly elongated at the margins. The cells in the uniseriate rays are slightly elongated axially.

MACERATION

The vessel segments are of irregular medium length and vary in shape. The pit markings are small and uniform in size. The fibers are of medium length and taper irregularly into sharp points.

DISTINGUISHING CHARACTERS

The wood has a spicy odor, is yellowish-brown in color with a waxy luster, diffuse porous, hard, with indistinct growth-rings. The vessels are visible with a lens, mostly in small radial groups, composed of irregular segments with simple perforations and small bordered or semibordered pits. The vessel lumina are plugged with tyloses and resinlike material. The rays are uniseriate, bi- or tri-seriate, and few more than 20 cells high. The fibers are rather thick-walled with medium-sized lumina and simple pits with oblique slitlike orifices. Wood-parenchyma is not abundant and mostly in contact with the vessels.

Order RUBIALES

Family RUBIACEAE

The Rubiaceae are trees, shrubs, or perennial, rarely annual, herbs, erect or climbing, comprising in all about 4,500 species of general distribution in the Tropics, and of which at least 50 species occur in Hawaii. Cinchona (yielding quinine), Ourouparia (yielding catechu), Coffea, and other important officinal plants belong to the Rubiaceae.

The wood is characterized by vessels with simple or, rarely, scalariform perforations and bordered or semibordered pits; rays, 1-8+ cells wide. Wood-parenchyma, little or abundant. Both simple and bordered pits occur in the wood-prosenchyma.

Gardenia brighami Mann. Nau. Material, lxxvii:x29:1501.

The genus Gardenia comprises about 70 species "distributed over tropical Africa, Asia, and Australia" (18). Two species are endemic to the Islands. *G. brighami,* according to Rock (18, p. 433), occurs on the dry leeward sides of Hawaii in association with

Xylosma, Nototrichium, *Bobea sandwicensis, Nothocestrum,* Osmanthus, Sideroxylon, and others. It is endemic to the Territory and is most abundant on Molokai. The tree grows to a height of 18 feet with a D. B. H. of 8 inches.

The wood is brownish-yellow in color, with a dull luster, diffuse porous, hard, cross-grained, of fine even texture, and with indistinct growth-rings.

CROSS SECTION

Gross.—The vessels are visible with a lens, rather numerous, mostly isolated, circular in outline, with open lumina filled with white gum and not permeable to alcohol. The rays are much narrower than the vessels.

Minute.—The vessels are circular in outline, of uniform size, thin-walled, mostly under 0.07 mm. in diameter and generally adjacent to fibers. The rays are 1-3 cells wide, minutely pitted, and filled with a deep-staining resinlike substance. The fibers are rounded polygonal in outline, in irregular order, with medium thick walls and open lumina. Bordered pits are present in both radial and tangential walls. Wood-parenchyma is fairly abundant; the cells, of about the same diameter as the fibers, and diffuse. Growth-rings are defined by zones of comparatively thick-walled but not compressed fibers associated with few wood-parenchyma cells.

RADIAL SECTION

Gross.—The rays are small, brownish, and not prominent. The wood is of fine uniform texture and color.

Minute.—The vessels are composed of rather short segments with large simple perforations of nearly the same diameter as the vessel lumen. Small circular-bordered pits with short lenticular orifices are formed in vertical rows in contact with the fibers, and semibordered pits of the same diameter varying from annular to piceiform in contact with the ray- or wood-parenchyma cells. Lateral circular perforations 0.012± mm. in diameter occur, here and there, communicating with adjacent ray- or wood-parenchyma cells. A few simple pits of the same diameter were found. It is possible that the perforations occur as a result of a breaking up of very delicate closing membrane subsequent to the death of the cell. The rays are imperfectly heterogeneous, being composed, as a rule, of radially elongated cells. Many marginal cells are nearly square. The pits are of small diameter. The fibers bear uniseriate circular-bordered pits with lenticular orifices. Elongated wood-parenchyma cells are scattering, and strands of short crystal-parenchyma cells common.

TANGENTIAL SECTION

Gross.—The rays are brownish in color, low, narrow, and visible under a lens.

Minute.—The rays are elliptical, mostly biseriate, and less than 17 cells high. The cells have thin walls, broadly elliptical in outline or slightly elongated at the margin of the ray. The fibers bear uniseriate circular-bordered pits with short lenticular orifices, in the tangential walls.

MACERATION

The vessel segments each usually bear one or two circular or subcircular perforations, 0.012± mm. in diameter, through the lateral walls. The terminal perforations are large and of nearly the same diameter as the vessel lumen. The pits are very small, not numerous or crowded. The fibers are mostly less than 1.3 mm. in length, wavy, and taper from near the middle to sharp points.

DISTINGUISHING CHARACTERS

The wood is brownish-yellow in color with a dull luster, diffuse porous, hard, cross-grained, of fine even texture, and with growth-rings. The vessels are very small, visible with a lens, circular in outline with lumina open and permeable to alcohol. The perforations are simple; the pits, mostly small, and numerous, and bordered or semibordered. The terminal perforations are simple and large. Small lateral perforations are present. The fibers bear uniseriate bordered pits, and have walls of medium thickness. Wood-parenchyma is diffuse. Short crystal-parenchyma strands are many. The rays are mostly biseriate and up to 17 cells high.

Plectronia odorata (Forst.) F. v. M. WALAHEE.

Material, lxxix:29:1507.

This species grows to a height of 20 feet, at low levels on the leeward side of Hawaii and of other Pacific islands. The wood is whitish-yellow in color with a dull luster, is diffuse porous with a tendency to be ring-porous, and hard.

CROSS SECTION

Gross.—Growth-rings are defined by narrow zones of fibers in which comparatively few vessels occur. The vessels are small, visible with a lens, and mostly isolated; the lumina open and readily permeable to alcohol; rays, slightly narrower than the vessels.

Minute.—The vessels are rather variable in diameter, and diminish in size in the late-wood, but rarely exceed 0.07 mm. in diameter. The rays are 1-3+ cells wide, and nearly free of cell contents. The walls bear minute circular pits. The fibers are rounded polygonal in outline, irregularly arranged, very thick-walled, and have small lumina. Wood-parenchyma cells are of nearly the same diameter as the fibers, thin-walled, and diffuse. The vessels are largely in contact with fibers.

RADIAL SECTION

Gross.—The rays are fine but easily visible without a lens. The surface is of fine even texture and of nearly uniform color.

Minute.—The vessels are composed of long segments with simple perforations somewhat smaller than the vessel lumen. The pits are small, circular in outline, not numerous, except in contact with ray- or wood-parenchyma or, rarely, other vessels. The pits are bordered or semibordered, and have short lenticular orifices in the vessel walls. The rays are heterogeneous, with cells that, as a rule, are radially elongated in the biseriate and triseriate portions and nearly square cells in the uniseriate parts or at the margins. The pits are minute, uniform in size and not numerous except in contact with vessels. The fibers bear uniseriate bordered pits with nearly vertical lenticular orifices. The pits of the wood-parenchyma cells are minute and commonly grouped or arranged in a circle within a thin-walled area.

TANGENTIAL SECTION

Gross.—The tangential surface is of fine uniform texture. The growth-ring zones are visible but not prominent.

Minute.—The rays are mostly elliptical in outline and 1-3+ cells wide; a few, uniseriate; others, uniseriate in part. Rays rarely exceed 25 cells in height. The cells in the uniseriate portions and ray margins are axially elongated. Those in the wider portions are nearly circular in outline. The fibers bear few pits in the tangential walls.

MACERATION

The vessel segments are long and cylindrical; the pit markings, small and variously arranged. The fibers are long, rather straight, of small diameter, and taper gradually into sharp points.

DISTINGUISHING CHARACTERS

The wood is whitish-yellow in color with a dull luster, diffuse or slightly ring-porous, and hard. The vessels are visible with a lens, mostly isolated, with bordered or semibordered pits of uniform size, simple perforations, and open lumina permeable to alcohol. The rays are 1-3+ cells wide and up to 25+ cells high. The fibers are thick-walled with small lumina and uniseriate bordered pits in the radial walls. Wood-parenchyma cells are many and diffusely distributed.

Bobea mannii Hbd. AHAKEA. Material, lxxiv:60:1508.

The genus Bobea is partly endemic to the Hawaiian islands, and comprises about five species. *Bobea mannii* is endemic and, according to Hillebrand (9, p. 173), occurs on Kauai at elevations of 2,000-3,000 feet. The wood is yellowish in color, diffuse porous, without growth-rings, rather hard, and straight-grained.

CROSS SECTION

Gross.—The vessels are visible with a lens, isolated or in mostly radial groups of 2-7+. The rays are of the same width as the vessels, and visible without a lens.

Minute.—The vessels are variable in size, especially in the groups, but rarely exceed 0.15 mm. in diameter. The walls are thin, the lumina open and readily permeable to alcohol. The rays are 1-4+ cells wide, free of contents, and with frequent minute, circular pits. The fibers are sharply polygonal in outline, arranged in fairly regular radial rows, and are of large diameter with thick walls and open lumina. The pits are simple or very narrowly bordered. Wood-parenchyma cells are of the same diameter as the fibers, but thin-walled, fairly numerous, and diffuse.

RADIAL SECTION

Gross.—The rays are low but distinct without a lens.

Minute.—The vessels are composed of long segments with small simple perforations of less than one-half the diameter of the vessel lumen. The pits are bordered or semibordered, small, of uniform size, and circular in outline with lenticular orifices in the vessel wall. The rays are composed of radially elongated cells in the wide portion and of nearly square cells in the uniseriate parts or at the margins. Some of the cells are axially elongated. The pits are small throughout. The fibers bear a few simple or narrowly bordered pits with slitlike orifices. Wood-parenchyma cells bear minute pits and are 0.18± mm. long.

TANGENTIAL SECTION

Gross.—The rays are low, elliptical, as broad as the vessels, and of nearly the same color as the adjacent tissues.

Minute.—The rays are 1-4+ cells wide, 1-33+ cells high, and uniseriate, uniseriate in part, or multiseriate, with cells subcircular in outline in the multiseriate portions and axially elongated cells in the uniseriate parts.

MACERATION

The fibers are long with uneven sides and taper gradually into sharp points.

DISTINGUISHING CHARACTERS

The wood is yellow in color, diffuse porous, without growth-rings, nonresinous, rather hard, and nearly straight-grained. The vessels are visible with a lens, mostly in radial groups, with small bordered or semibordered pits of uniform size and small simple perforations. The rays are 1-4+ cells wide, 1-30+ cells high, and heterogeneous. The fibers are of large diameter, thick-walled with open lumina, and bear simple or narrowly bordered pits. Wood-parenchyma is fairly abundant and diffuse.

Straussia hawaiiensis Gray. KOPIKO ULA.

Material, lxxxi:79:1497.

The genus Straussia is endemic to Hawaii, where it is represented by 7 species. It is related to Psychotria and Chasalia with American and Asiatic affinities, and consists of "trees and dichotomous terete branches" (9, p. 178). *S. hawaiiensis* grows to a height of 20-35 feet, with a diameter of about 12 inches. It occurs on the leeward side of Hawaii, at elevations of about 3,000 feet, in association with Metrosideros, Myoporum, Xylosma, and Clermontia (18, p. 453). The wood is reddish-brown in color, rather hard, diffuse porous, with indistinct growth-rings.

CROSS SECTION

Gross.—The vessels are visible with a lens, rather numerous, in loose radial arrangement; the lumina, open and permeable to alcohol. The rays are broader than the vessels.

Minute.—The vessels are variable in size but rarely exceed 0.09 mm. The rays are multiseriate, minutely pitted, and contain globules of deep-staining substance. The fibers are rounded polygonal in outline, with rather thick walls; the lumina, of medium diameter; the pits narrowly bordered or simple. Wood-parenchyma is little developed.

RADIAL SECTION

Gross.—The fibers are intercrossed; the rays, easily visible, and reddish-brown in color.

Minute.—The vessels are composed of long segments with numerous small bordered or semibordered pits with short lenticular orifices in the vessel walls. The perforations are simple, circular or elliptical in outline, many less than one-half the diameter of the vessel lumen, and commonly lateral as well as terminal in position. The rays are composed partly of radially elongated cells, partly of nearly square cells. Axially elongated cells are often found at the margin. The pits are small, circular in outline, and rather numerous. Globules of a deep-staining substance are present in the cell cavities. The fibers bear many simple or narrowly bordered pits with oblique extended slitlike orifices.

TANGENTIAL SECTION

Gross.—The wood is of fine uniform texture. The rays are small and indistinct under a lens.

Minute.—The rays are for the most part broadly elliptical in outline, mainly under 6 cells broad and less than 50 cells high. The cells are irregular in size and shape, those in the interior of the ray being generally smaller and subcircular in outline. Those at the sides and margins are generally irregularly elongated axially. There are few uniseriate rays. The fibers are irregularly intercrossed and have few pits in the tangential walls.

MACERATION

The tracheal segments as a rule terminate beyond the perforation in a tonguelike or tracheidlike projection. The fibers are mostly less than 1.3 mm. in length and taper irregularly into mostly short obtuse ends.

DISTINGUISHING CHARACTERS

The wood is reddish-brown in color, rather hard, diffuse porous, and with indistinct growth-rings. The vessels are visible with a lens, in loose radial arrangement; the lumina, open and permeable to alcohol. The rays are broader than the vessels, heterogeneous, 1-6+ cells broad, and typically less than 50 cells high. The fibers have rather thick walls, lumina of medium size, and simple or narrowly bordered pits. There is little wood-parenchyma.

Straussia kaduana (Cham. et Schlecht.) Gray. KOPIKO KEA.

Material, lxxxii :11 :1500.

This species occurs mainly in the mountains of Oahu, reaching a height of 20 feet. The wood is grayish-brown in color, diffuse porous, rather soft, without growth-rings, cross-grained, and of fine even texture.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, mostly in radial rows of 2-10+; the lumina, mostly filled with tyloses and not permeable to alcohol. The rays are narrower than the vessels.

Minute.—The vessels are somewhat variable in diameter, but rarely exceed 0.12 mm. The rays are commonly less than 6 cells wide, with resinlike globular contents. The fibers have walls of medium thickness and large open lumina. There is little wood-parenchyma.

RADIAL SECTION

Gross.—The rays are reddish-brown, small, and not prominent.

Minute.—The vessels are composed of exceptionally long segments with simple perforations, some in twos and many less than one-half the diameter of the vessel lumen. The pits are mainly small, circular in outline and bordered or semibordered, with lenticular orifices in the vessel walls, but vary slightly in contact with the rays, tending to become elongated and even simple. Tyloses are abundant. The rays are composed of three types of cells: (1) a low radially elongated type commonly in the interior of multiseriate portions; (2) cells nearly square in outline, in the uniseriate portions and at the sides of the multiseriate parts; (3) axially elongated cells, as a rule at the margins. The pits are small, numerous, circular in outline, uniform in size and shape, except in contact with vessels where larger, variable, elongated semibordered, or, rarely, simple pits occur. Deep-staining resinlike contents are present in the cells. The fibers are septate and bear irregularly arranged piceiform-bordered pits.

TANGENTIAL SECTION

Gross.—The wood is of fine uniform texture. The rays are reddish, small, and visible with a lens.

Minute.—The rays are of a variable, narrowly elliptical outline with acute ends, 1-4+ cells wide and generally less than 25 cells high. The cells in the interior of multiseriate parts are commonly small and slightly or not at all elongated; those at the sides and in the uniseriate parts, for the most part moderately elongated axially; many of those at the margins greatly elongated axially. The fibers bear few pits in the tangential walls.

MACERATION

The vessel segments are sometimes found truncate, and bearing a tonguelike projection from one or both ends, and many terminate in tracheidlike ends of considerable length. The fibers are broad and prismatic in the central portion, with short attenuate, mostly unpitted, rather obtusely pointed ends, and a few are as much as 2+ mm. in length.

DISTINGUISHING CHARACTERS

The wood is grayish-brown in color, diffuse porous, rather soft, without distinct growth-rings, cross-grained, and of fine even texture. The vessels are visible with a lens, mainly arranged in radial groups, have tyloses, and are slowly or not at all permeable to alcohol. The perforations are simple, and smaller than the vessel lumen. The pits are mainly small, bordered or semibordered, or, rarely, simple. The fibers have medium-thick walls, large open lumina, and bordered pits in the radial walls. The rays are heterogeneous, composed of three cell types, 1-4+ cells broad and as a rule less than 25 cells high. Wood-parenchyma is nearly absent.

Straussia onocarpa Hbd. KOPIKO. Material, lxxiii:64:1504.

This species is endemic to the Territory, grows to a height of 50 feet at elevations of about 2,800 feet, and is not abundant. The wood is rather hard, deep reddish-brown in color, diffuse porous, and without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are extremely small, visible under good lens, isolated or in small radial groups, with open lumina permeable to alcohol. The rays are broader than the vessels, and visible with a lens.

Minute.—The vessels are rather variable in diameter, some of them not easily distinguished from the fibers; the largest, rarely over 0.09 mm. in diameter. The walls are thin (0.003 mm.). The fibers have walls about twice as thick as the vessel walls, large open lumina, and simple or very narrowly bordered pits. The rays are multiseriate and have a maximum width greater than that of the vessels. The ray-cells and some of the fibers contain globules of resinlike substance. Wood-parenchyma is nearly absent.

RADIAL SECTION

Gross.—The texture is very fine and even. A reddish resinlike substance is present in the rays and other elements.

Minute.—The vessels bear small circular-bordered or semibordered pits of uniform size; the perforations, simple, many of them less than one-half the diameter of the vessel lumen; the segments, exceptionally long. The rays are composed of radially elongated cells in the interior, and of one or more rows of axially elongated cells at the margin. Cells square in outline occur in other portions. The fibers bear numerous simple pits with slitlike orifices and are septate.

TANGENTIAL SECTION

Gross.—The wood is of fine uniform texture with resinlike material in the elements. The rays are fine and indistinct.

Minute.—The rays are mainly elliptical in outline, some with long uniseriate margins, 1-6+ cells broad and generally less than 30 cells high.

The cells in the interior of multiseriate parts are mainly small, variable, but as a rule not greatly elongated. Those at the sides, margins, and uniseriate portions are mainly axially elongated. The fibers bear few or no pits in the tangential walls.

MACERATION

The tracheal segments are uniformly very long (1.3± mm.). The pit markings are small, circular, uniform in size, and numerous. The perforations are simple, many less than one-half the diameter of the vessel lumen, and sometimes two are found near together. Many of the segments terminate beyond the perforation in tracheid-like ends. Tonguelike projections also occur. The fibers are prismatic or subcylindrical in shape, with short, attenuate, mostly unpitted, rather obtuse, irregular ends, and few exceed 1.9 mm. in length.

DISTINGUISHING CHARACTERS

The wood is rather hard, deep reddish-brown in color, diffuse porous, and without distinct growth-rings. The vessels are visible with a lens, and composed of very long segments with small simple perforations, small circular-bordered or semibordered pits, and open lumina. The rays are heterogeneous, 1-6+ cells wide, and generally less than 30 cells high. The fibers have walls of medium thickness, large open lumina, and simple pits. Wood-parenchyma is nearly absent.

Psychotria hexandra Mann. Material, lxxx:x18:1506.

The genus comprises 350 species, distributed generally in the Tropics. *P. hexandra* occurs on Kauai and Oahu, and is endemic to Hawaii. The tree grows to a height of 20 feet. The wood is grayish-brown in color, diffuse porous, rather soft, cross-grained, of fine even texture, and without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, arranged mainly in radial rows of 2-10+ together. The wide rays are of nearly the same width as the diameter of the large vessels.

Minute.—The size of the vessels is somewhat variable but seldom found to exceed 0.12 mm. The lumina are open or with few tyloses, and permeable to alcohol. The rays are 1-6 cells wide and contain a resinlike substance. The pits are small, subcircular, and rather numerous. The fibers are rounded polygonal in outline with medium-thick walls and large lumina. The pits are simple and mostly in the radial walls. There is little wood-parenchyma.

RADIAL SECTION

Gross.—The rays are reddish, small, not prominent; texture and color are nearly uniform.

Minute.—The vessels are composed of long (1.3± mm.) segments with small circular perforations, many of which are less than one-half the diameter of the vessel lumen. The pits are small, circular in outline, uniform in size, and bordered or semibordered, with short lenticular orifices in the vessel wall. The rays are composed of radially elongated cells in the multiseriate interior, and of square or axially elongated cells at the sides, uniseriate portions, or at the margins. The pits are small, circular in outline, and of uniform size. The fibers are septate and bear numerous simple pits with slitlike orifices in the radial walls.

TANGENTIAL SECTION

Gross.—The rays are small, and visible with a lens.

Minute.—The rays are 1-6+ cells wide and mainly less than 20 cells high, with rounded cells of variable small size in the multiseriate portion and axially elongated cells in the uniseriate parts or at the margins, or, in some rays, at the sides. The fibers bear few or no pits in the tangential walls.

MACERATION

Many of the vessel segments terminate in tracheid- or tongue-like ends, and approach the fibers in length. The fibers are long (1.9± mm.) wide, pitted on the radial walls, except for the short irregularly tapering ends.

DISTINGUISHING CHARACTERS

The wood is grayish-brown in color, diffuse porous, rather soft, cross grained, of fine even texture, and without distinct growth-rings. The vessels are visible in cross-section with a lens, mainly in radial groups of 2-10+, and with lumina with few tyloses, but permeable to alcohol. The segments are long; the perforations, simple and small; the pits, small, circular, uniform in size, and bordered or semibordered. The rays are irregularly heterogeneous, 1-6+ cells wide and as a rule less than 20 cells high. The fibers are medium thick-walled, with open lumina. Wood-parenchyma is nearly absent. Wood very similar to lxxxiii, which is evidently *Straussia onocarpa.*

Coprosma rhynchocarpa A. Gray. Pilo.

Material, lxxxvi:82:1496.

The genus comprises about 50 species, of which the majority are found in New Zealand. *C. rhynchocarpa* is a small tree 20 feet high, endemic to Hawaii, at elevations of 4,000-6,000 feet. The wood is whitish-yellow in color or gray from fungi, diffuse porous, soft, straight-grained, and without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, mostly in radial or sometimes tangential compact groups of 2-10+ together. The lumina are open and permeable to alcohol. The rays are smaller than the vessels.

Minute.—The vessels are of variable size but rarely exceed 0.15 mm. in diameter, and have thin walls. The rays are 1-4+ cells wide and with numerous circular pits 0.006± mm. in diameter, mostly in radial rows; cell cavities mostly without contents. The fibers are rounded polygonal in outline, with very thin walls and open lumina; large diameters occur in regular radial arrangement in alternation with the small diameters (of the fiber ends). Wood-parenchyma is difficult to distinguish from the fibers, has slightly thinner walls, is abundant, surrounds the vessels, and is diffusely distributed among the fibers.

RADIAL SECTION

Gross.—The elements are serried. The rays are of the same light color as the other tissues, fine and not prominent. The texture is fine and uniform.

Minute.—The vessels are composed of segments of medium length with commonly large simple perforations. The pits are bordered or semibordered, small, numerous, often crowded, and nearly uniform in size. The fibers are without septae, and have numerous small simple pits with short, oblique, open, lenticular orifices. Wood-parenchyma cells are abundant, distinguished from the fibers by their transverse walls, and by the larger grouped pits. Microscopic growth-rings are indistinctly defined by slightly compressed, slightly thicker walled fibers.

TANGENTIAL SECTION

The rays are 1-4+ cells broad, and mostly less than 35 cells high. Multiseriate rays are composed of rounded cells of somewhat variable size, but infrequently elongated. The uniseriate rays are composed either of rounded or slightly elongated cells. The fibers bear pits in the tangential walls.

MACERATION

The vessel segments are mainly truncate at the ends; the fibers, rather long and broad, cylindrical in the central portion, with rather long, attenuate, mostly unpitted, extremely delicate ends.

DISTINGUISHING CHARACTERS

The wood is whitish in color, diffuse porous, soft, straight-grained, and with often indistinct microscopic growth-rings. The vessels are of small diameter and composed mainly of truncate segments of medium length with simple perforations and bordered or semibordered pits, all of nearly uniform size. The fibers are rather long and broad, with rounded outlines in cross-section; the walls, thin; the pits, simple, and present in all walls. Wood-parenchyma is abundant, of nearly the same diameter as the fibers, but with slightly thinner walls, and disposed around the vessels or diffusely among the fibers.

Coprosma longifolia A. Gray. PILO. Material, lxxvi:48:1498.

C. longifolia is endemic to Hawaii and attains a height of about 15 feet with a short trunk of several inches in diameter. It is reported from Kauai and Oahu, at elevations of about 2,500 feet.

The wood is soft, grayish or bluish-white in color, with a silky luster, diffuse porous, without distinct growth-rings.

CROSS SECTION

Gross.—The vessels are small, visible with a lens, and mostly arranged in small compact groups of 2-6+ together. The size is variable but vessels rarely exceed 0.12 mm. in diameter; the lumina, open and permeable to alcohol. The rays are 1-4+ cells wide, mostly without cell-contents; the pits, mostly small and irregularly arranged, but variable. The fibers are mostly somewhat compressed, with the tangential diameter greater than the radial; the walls, rather thin; the lumina, open; the pits, simple and mostly present in the radial walls. Wood-parenchyma occurs mainly in contact with or adjacent to vessels.

RADIAL SECTION

Gross.—The rays are small but distinct. An amber-colored substance is present in the rays and vessels.

Minute.—The vessels are composed of rather long segments with simple perforations terminal or lateral in position and mostly smaller than the vessel lumen. The pits are large but variable in size and shape from circular or long elliptical or, rarely, scalariform; those in contact with parenchyma vary from semibordered to simple. The rays are composed mostly of radially elongated cells in the central portion and of axially elongated cells at the margin. The pits are small and subcircular, except where in contact with vessels, where large irregularly elliptical semibordered or simple pits occur. The fibers bear simple pits in the radial walls with slitlike orifices extending beyond the closing membranes.

TANGENTIAL SECTION

Gross.—The rays are small but distinct by reason of their brownish contents.

Minute.—The rays are heterogeneous, 1-4+ cells wide and as a rule less than 35 cells high. The cells of the wide rays are variable in size and shape but mostly small and rounded in the interior and elongated at the margins. Those in the uniseriate rays are also more or less elongated. The fibers are unpitted in the tangential walls.

MACERATION

The vessel segments terminate, as a rule, in tonguelike or tracheid-like ends. The fibers are long, narrow, straight, and taper from near the middle into long sharp ends.

DISTINGUISHING CHARACTERS

The wood is soft, grayish- or bluish-white in color with a silky luster, diffuse porous, and without distinct growth-rings. The vessels are visible in cross section with a lens, and mainly arranged in small compact groups; perforations simple; pits bordered, semibordered, or simple, large and variable in outline. The rays are heterogeneous, 1-4+ cells wide, and less than 35 cells high. The fibers have rather thin walls, large lumina, simple pits in the radial walls, and are slightly compressed radially. Wood-parenchyma occurs mostly in contact with the vessels.

Morinda citrifolia Linn. NONI KUAHIWI.

Material, lxxxv:26:1503.

The genus Morinda comprises about 46 species of shrubs, trees, or climbers distributed in tropical climates of both hemispheres. It is best represented in Asia and the Oceanic islands. *M. citrifolia* is a cosmopolitan species believed to have been introduced at an early date by the Hawaiians. It occurs in cultivated areas, and was valued because of dye obtained from roots and bark. The fruit yields an oil and is eaten in Fiji. The tree reaches a height of only 15 feet, with a trunk of a few inches in diameter. The wood is deep yellow in color, diffuse porous, soft, straight-grained, without growth-rings, and of fine uniform texture.

CROSS SECTION

Gross.—The vessels are visible with a lens, isolated or in small rather compact radial and tangential groups. Some of the lumina are plugged with a yellowish substance but are usually open and the wood very permeable to alcohol. The rays are not as wide as the vessels.

Minute.—The vessels have very thin walls and are variable in size but rarely exceed 0.19 mm. in diameter. The rays are 1-4+ cells wide and bear minute pits. The fibers are not as numerous as wood-parenchyma, are rounded polygonal in outline, rather thick walled with open lumina of medium size, and few pits. Wood-parenchyma is of the same diameter as the fibers, thin-walled, very abundant, and diffusely distributed.

RADIAL SECTION

Gross.—The wood is of even texture and color, with a dull luster. The rays are not distinct.

Minute.—The vessels are composed of rather short segments with large simple perforations and small, numerous bordered or semibordered pits of uniform size. The rays are composed mainly of radially elongated or square cells commonly in the ventral portions, with many axially elongated cells at the margins. The pits are small.

TANGENTIAL SECTION

Gross.—The surface is of uniform texture with indistinct structural features.

Minute.—The rays are 1-4+ cells wide and may exceed 60 cells in height. The cells are mainly irregularly elliptical in outline with many axially elongated cells at the margins or sides.

MACERATION

The vessel segments are mainly truncate; the fibers, long, narrow, rather straight, with long attenuate sharp points.

DISTINGUISHING CHARACTERS

The wood is deep-yellow in color, with dull luster, diffuse porous, soft, straight-grained, without growth-rings, and of fine uniform texture. The vessels are rather large but indistinct without a lens, isolated or arranged in small compact groups, have mostly open lumina, short segments, large simple perforations, and small numerous bordered or semibordered pits. The rays are 1-4+ cells broad, and some of them exceed 60 cells in height. The fibers have rather thick walls, lumina of medium size, few pits, and are not as abundant as the parenchyma, which is of the same diameter as the fibers and diffusely distributed.

Order CAMPANULALES

Family COMPOSITAE

The Compositae comprise about 10,000 species of herbs, shrubs or, rarely, trees of general distribution especially in warm climates. The 56 endemic Hawaiian representatives show American affinities. Raillardia is a xerophytic genus of high elevations. The wood is characterized by vessels with simple or rarely scalariform perforations, bordered or semibordered pits. The rays are variable, and sometimes lacking. The interior of the broad rays is composed of radially elongated cells surrounded by axially elongated cells that merge gradually into prosenchyma. The fibers bear simple pits and may be septate. Wood-parenchyma occurs mainly near or in contact with vessels.

Dubautia plantaginea Gaud. NAENAE. Material, xxii:1:1439.

The genus Dubautia is endemic to Hawaii and shows affinities with Raillardella of isthmian America. *D. plantaginea* is a small tree, 10-16 feet high, of general distribution in the rain forest of the islands. The wood is light grayish-yellow, rather soft, of fine even texture, without growth-rings or distinct heartwood, and is straight-grained.

CROSS SECTION

Gross.—The vessels are visible with a lens, diffusely distributed, smaller than the rays, isolated or in small compact groups of 2-3+ together. The lumina are without tyloses or other contents. The rays are light-colored but not prominent.

Minute.—The vessels vary slightly in size but few exceed 0.16 mm. in diameter. The walls are thin and lateral perforations many (fig. 8, *b*). The rays are multiseriate and composed of cells of slight if any elongation; the pits are minute and numerous. The fibers are rounded polygonal in outline, rather thin-walled with open lumina, and bear numerous simple pits in the radial and tangential sides; they occur in regular radial arrangement, the large diameters in orderly alternation with small diameters of the fiber points as in Charpentiera (fig. 2, *b*). Wood-parenchyma is not abundant and is mostly in contact with vessels.

RADIAL SECTION

Gross.—The rays may reach a height of 4+ mm. but are not prominent. The elements are serried.

Minute.—The vessels are composed mainly of shrot truncate segments with large simple perforations, or occasionally found with lateral perforaations or with tracheid-like or tonguelike ends (fig. 8, *A* and *B*). The pits are numerous, small, circular or elliptical, bordered or semibordered, but not simple. The rays are composed of cells nearly square in outline or elongated axially; the pits, numerous, minute, and subcircular, and not large in contact with vessels. The fibers bear minute simple pits in vertical arrangement.

TANGENTIAL SECTION

Gross.—The wood is of uniform texture. The rays are indistinct; many of the vessels are slightly dark-colored.

Minute.—The rays are multiseriate, elliptical in outline with acute margins, usually less than 4 mm. high and less than 0.2 mm. broad. The cells are variable in size, and mostly somewhat axially elongated. At the sides elongated cells occur merging into the prosenchyma.

MACERATION

The fibers are short and broad, cylindrical in the central portion with short tapering rather obtuse points.

DISTINGUISHING CHARACTERS

The wood is light-colored, soft, diffuse porous, and without growth rings. The elements are serried. The vessels are small, visible in cross section with a lens, isolated or in small compact groups, and are composed of short segments with mainly truncate ends, large simple perforations, small bordered or semibordered pits, and open lumina. The fibers have rather thin walls, large open lumina, and simple pits. Wood-parenchyma is not abundant and is mostly in contact with vessels.

KEY

(1) Secondary growth present (2).
(1) Secondary growth absent .... *Pandanus tectorius,* p. 240
(2) Vessels present (3).
(2) Vessels absent, tracheids in bundles .... *Dracaena aurea,* p. 241
(3) Wood with intraxylary phloem, or other soft tissue which withers away on drying, leaving the wood chambered (4).
(3) Wood not chambered (8).
(4) Raylike strands present (5).
(4) Raylike strands absent .... *Nototrichium sandwicense,* p. 251
(5) Strands distinct (6).
(5) Strands not distinct .... *Pisonia grandis,* p. 257
(6) Strands as broad as the vessels .... *Charpentiera obovata,* p. 249
(6) Strands narrower than the vessels (7).
(7) Wood separating into concentric lamellae .... *Pisonia excelsa,* p. 254
(7) Wood not separating into concentric lamellae .... *Pisonia sandwicensis,* p. 255
(8) Vessels with scalariform perforations (9).
(8) Vessels with simple perforations (10).
(9) Wood red .... *Byronia sandwicensis,* p. 293
(9) Wood whitish .... *Perrottetia sandwicensis,* p. 295
(10) Ray-vessel pits varying from semibordered to simple (11).
(10) Ray-vessel pits semibordered (29).
(11) Wood-parenchyma in zones, tangential lines, or diffuse (12).
(11) Wood-parenchyma limited to the vicinity of vessel, or absent (19).
(12) Wood-parenchyma diffuse (13).
(12) Wood-parenchyma in zones, tangential lines (14).
(13) Rays mainly 1 cell wide (18).
(13) Rays 1-3 cells wide .... *Cryptocarya mannii,* p. 259
(14) Vessels mainly grouped (15).
(14) Vessels mainly isolated (17).
(15) Vessels in large radio-tangential groups of often more than 20 .... *Sideroxylon sandwicense,* p. 338
(15) Vessels in small groups (16).
(16) Wood-parenchyma abundant, in broad tangential lines .... *Eugenia malaccensis,* p. 318
(16) Wood-parenchyma not abundant, in fine tangential lines .... *Eugenia sandwicensis,* p. 320
(17) Rays mainly uniseriate .... *Calophyllum inophyllum,* p. 308
(17) Rays 1-4 cells wide .... *Rauwolfia sandwicensis,* p. 344
(18) Vessels mainly isolated .... *Aleurites moluccana,* p. 287
(18) Vessels mainly in radial rows .... *Euphorbia rockii,* p. 289
(19) Pits between vessels circular, or nearly so, in outline (24).
(19) Pits between vessels varying to scalariform (20).
(20) With secretory canals in the rays (21).
(20) Without secretory canals in the rays (22).
(21) Rays usually less than 5 cells wide .... *Panax gaudichaudii,* p. 327
(21) Rays often over 5 cells wide .... *Panax platyphyllum,* p. 329
(22) Wood rather hard (23).

(22) Wood soft .... *Elaeocarpus bifidus,* p. 303
(23) Rays 1-3 cells wide .... *Tetraplasandra waimeae,* p. 323
(23) Rays 1-6 cells wide .... *Dipanax gymnocarpa,* p. 325
(24) Vessels mainly isolated (25).
(24) Vessels mainly grouped (28).
(25) Wood nearly white .... *Solanum sandwicense* var. β, p. 349
(25) Wood red, brown, or yellow (26).
(26) Wood red .... *Metrosideros villosa,* p. 321
(26) Wood yellow or brown, rather hard (27).
(27) Wood yellow, soft, or with reddish brown heartwood .... *Artocarpus incisa,* p. 243
(27) Wood brownish yellow, rather hard .... *Rhus semialata,* var. *sandwicensis,* p. 291
(28) Vessels in small compact groups .... *Solanum sandwicense,* p. 349
(28) Vessels in long radial rows .... *Pipturus gaudichaudianus,* p. 245
(29) Wood-parenchyma more or less abundant, in zones, tangential lines, or diffuse (30).
(29) Wood-parenchyma limited to the vicinity of vessels or absent (58).
(30) Wood-parenchyma in zones or tangential lines (31).
(30) Wood parenchyma diffuse (47).
(31) Vessels mainly isolated (32).
(31) Vessels mainly grouped (37).
(32) Rays often over 20 cells broad .... *Erythrina monosperma,* p. 273
(32) Rays under 20 cells broad (33).
(33) Wood soft, whitish yellow .... *Sapindus saponaria,* p. 297
(33) Wood red, brown, or blackish (34).
(34) Wood soft .... *Terminalia catappa,* p. 315
(34) Wood hard (35).
(35) Rays 1-6 cells broad .... *Cyathodes tameiameiae,* p. 332
(35) Rays 1-2 cells broad (36).
(36) Fibres often with concentric lamellae .... *Mezoneurum kauaiense,* p. 269
(36) Fibres usually without concentric lamellae .... *Dodonea viscosa,* p. 153
(37) Rays mainly uniseriate .... *Ochrosia sandwicensis,* p. 346
(37) Rays often more than 1 cell wide (38).
(38) Rays 1-7 cells broad (39).
(38) Rays less than 7 cells broad (41).
(39) Wood very hard .... *Sophora chrysophylla,* p. 271
(39) Wood soft (40).
(40) Wood-parenchyma in distinct zonal arrangement .... *Gossypium drynariodes,* p. 306
(40) Wood-parenchyma in indistinct tangential rows .... *Hibiscus arnottianus,* p. 305
(41) Wood whitish and soft or rather soft (42).
(41) Wood red or reddish brown (45).
(42) Rays 1-2 cells broad, vessels mainly in radial rows .... *Melicope cinerea,* var. δ, p. 284
(42) Rays 1-3 cells broad, vessels mainly in small radial groups (43).
(43) Wood-parenchyma in broad, distinct zones (44).

(43) Wood-parenchyma in narrow, rather indistinct zones.......... *Pelea sandwicensis*, p. 283
(44) Wood-parenchyma cells with radial diameter twice that of the fibers.......... *Zanthoxylum oahuense*, p. 276
(44) Wood-parenchyma cells with radial diameter less than twice that of the fibers.......... *Zanthoxylum depetalum*, var. β, p. 281
(45) With crystal-parenchyma (46).
(45) Without crystal-parenchyma.......... *Osmanthus sandwicensis*, p. 342
(46) Wood-parenchyma abundant in numerous narrow zones.......... *Maba sandwicensis*, p. 340
(46) Wood-parenchyma not abundant, zones narrow, wide apart, and often indistinct.......... *Colubrina oppositifolia*, p. 300
(47) Vessels mainly isolated (48).
(47) Vessels mainly grouped (53).
(48) Crystal-parenchyma present (49).
(48) Crystal-parenchyma absent (52).
(49) Vessels seldom grouped (50).
(49) Vessels occasionally grouped.......... *Zanthoxylum kauaiense*, p. 278
(50) Wood brownish (51).
(50) Wood whitish.......... *Santalum freycinetianum*, p. 246
(51) Crystal-parenchyma abundant.......... *Gardenia brighami*, p. 352
(52) Wood yellow, rather soft.......... *Bobea mannii*, p. 355
(52) Wood whitish, hard.......... *Plectronia odorata*, p. 354
(52) Wood yellow, rather soft.......... *Bobea mannii*, p. 355
(53) Crystal-parenchyma present (54).
(53) Crystal-parenchyma absent (55).
(54) Wood whitish, hard.......... *Zanthoxylum dipetalum* var. γ, p. 282
(54) Wood brownish, rather hard.......... *Zanthoxylum dipetalum*, p. 281
(55) Wood hard or rather hard (56).
(55) Wood soft (57).
(56) Rays 1-7 cells broad.......... *Zanthoxylum mauiense*, p. 279
(56) Rays 1-4 cells broad.......... *Platydesma campanulatum*, p. 286
(57) Whitish .... *Coprosma rynchocarpa*, p. 361
(57) Deep yellow.......... *Morinda citrifolia*, p. 364
(58) Fibres septate (59).
(58) Fibres nonseptate (64).
(59) Rays mainly 1-2 cells broad.......... *Xylosma hawaiiense*, p. 310
(59) Rays often over 2 cells broad (60).
(60) Rays very broad, sometimes 15 cells.......... *Myrsine lessertiana*, p. 336
(60) Rays 6 cells broad (61).
(61) Wood hard.......... *Straussia hawaiiensis*, p. 356
(61) Wood rather hard (62).
(62) Rays 1-4 cells broad.......... *Straussia kaduana*, p. 358
(62) Rays 1-6 cells broad (63).
(63) Vessels seldom more than 0.09 mm. in diameter, wood deep reddish brown.......... *Straussia onocarpa* var. β, p. 359
(63) Vessels sometimes 0.12 mm. in diameter, wood light, reddish brown.......... *Psychotria hexandra*, p. 360
(64) Wood yellowish or whitish (65).

(64) Wood brown or red (68).
(65) Wood soft (66).
(65) Wood rather hard (70).
(66) Rays mostly less than 4 cells broad (67).
(66) Rays mostly over 4 cells broad........................*Dubautia plantaginea,* p. 365
(67) Rays 1-2 cells broad................................*Wilkstroemia sandwicensis,* p. 313
(67) Rays 1-4 cells broad..*Coprosma longifolia,* p. 362
(68) Rays mostly uniseriate..*Acacia koa,* p. 266
(68) Rays often more than 1 cell wide (69).
(69) Crystal-parenchyma present..*Acacia koaia,* p. 268
(69) Crystal-parenchyma absent...........................*Myoporum sandwicense,* p. 351
(70) With growth-rings plainly defined by zones of laminated, mucilage-reacting fibres..*Alphitonia excelsa,* p. 301
(70) Without zones of laminated fibres (71).
(71) Vessels isolated or in small irregular groups..*Pittosporum glomeratum,* p. 261
(71) Vessels mainly in radial arrangement (72).
(72) Rays 1-6 cells wide...*Pittosporum hosmeri,* p. 263
(72) Rays 1-10 cells wide...*Pittosporum kauaiense,* p. 264

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OCCASIONAL PAPERS

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NEW OR LITTLE-KNOWN HAWAIIAN FISHES

BY

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Henry W. Fowler of the Academy of Natural Sciences of Philadelphia, was elected a Bishop Museum Fellow in Yale University for the year 1922-23. Through the courtesy of the Academy Mr. Fowler was enabled to devote his attention to the study and identification of the large collection of fishes stored in the Bishop Museum. Arrangements between the Academy of Natural Sciences and the Bishop Museum provide for the continuation of icthyological studies.

New or Little-Known Hawaiian Fishes

BY HENRY W. FOWLER.

While working over the fishes in the Bishop Museum, I have found a number of interesting new species and several species of signal rarity or not previously reported from Hawaii. This paper includes preliminary descriptions of the new species and a list of the names of those already described elsewhere. Unless otherwise stated, all the records pertain to Honolulu.

EULAMIIDAE

Eulamia munsing (Bleeker).

ECHINORHINIDAE

Echinorhinus brucus (Bonnaterre).

MOBULIDAE

Manta birostris (Walbaum).

CLUPEIDAE

Stolephorus delicatulus (Bennett).

GONORHYNCHIDAE

Gonorhynchus gonorynchus (Gmelin).

CONGRIDAE

Conger wilsoni (Schneider).

MURAENIDAE

Gymnothorax hepaticus (Rüppell).
Gymnothorax tile (Buchanan-Hamilton).

EXOCOETIDAE

Cypselurus spilopterus (Valenciennes).

CENTRISCIDAE

Centriscus strigatus (Günther).

SYNGNATHIDAE

Corythoichthys mataafae Jordan and Seale.

Two from Waikiki.

BERYCIDAE

Beryx decadactylus Cuvier.

ZEIIDAE

Zenopsis nebulosus (Schlegel).

SCOMBRIDAE

Thunnus thynnus (Linné).

Germo macropterus (Schlegel).

Nesogrammus thompsoni new species.

Head 3 2/3; depth 4 2/5; D. XI, III, 14-6; A. III, 11-5; P. II, 13; V. I, 5; scales 168 from upper edge of gill-opening, in median lateral series, to caudal base; head width 2 in its length; mandible 2; snout 2 3/4; eye 5 2/3; maxillary 2 1/4; interorbital 3 1/8; third dorsal spine 11 1/4; first branched dorsal ray 2 1/3; first branched anal ray 2 3/5; least depth of caudal peduncle 7 1/2; greatest width of caudal peduncle 3 1/3; upper caudal lobe 1 1/3; pectoral 1 5/6; ventral 2 1/8.

Body elongately fusiform, moderately compressed, deepest midway in its length and profiles similarly and evenly curved. Caudal peduncle greatly depressed, forming broad adipose keel each side, which begins about opposite root of penultimate finlets. Small low oblique keel over base of each caudal lobe.

Head attenuated, compressed moderately and convex sides slightly more approximate below than evenly convex upper surface. Snout broadly conic, about wide as long. Eye moderate, high, hind pupil edge midway in head, without adipose eyelid. Mouth large, gape evenly curved and closed jaws even in front. Maxillary extends opposite first third in head, most of its upper edge slipping below narrow preorbital, and expansion half of eye. Teeth in jaws uniserial, lower larger and little wider spaced, and several larger teeth forward above each side. Transverse arc of small teeth on vomer uniserially. Row of small teeth along each palatine. Tongue broad, depressed, smooth, free all around front edge. Nostrils well separated, front one small pore eye-diameter before eye, and hind one oblique slit little nearer anterior than eye. Interorbital broadly and evenly convex. Preopercle entire, its contour evenly convex.

Gill-opening forward opposite posterior nostril. Gill-rakers as 0 to VII minute denticles, well spaced, but slightly protruding above finely asperous surface of cerato-branchial and gill-filaments 1 1/5 in eye. Pseudobranchiae well developed, 2/3 of gill-filaments. Isthmus long, slender and narrowly constricted to thin keel anteriorly.

Head with very finely imbedded scales, weak, mostly lateral and largely absent from muzzle and interorbital. Trunk covered with thin weak scales, each of larger ones more or less surrounded by smaller or minute ones, also surrounding and connecting thin membranes greatly porous, producing finely cavernous condition. Except spinous dorsal fins all with usual close-set transverse thin scales of closely fused scombroid squamation. Only one lateral line completely developed, extends from above suprascapular region until opposite depressed pectoral end, then curving suddenly down as loop well behind pectoral tip, up again opposite vent, though obliquely toward last dorsal ray (really a finlet joined with dorsal) and angle or point of ascension at upper 2/5 in body depth; then abruptly falls again to form ventral loop opposite last anal ray (really a finlet joined with anal), finally ascending and running close along upper surface of keel on caudal peduncle. An incomplete or accessory lateral line extends from upper part of gill-opening above and about far back as depressed pectoral tip, when obliterated. Scales cycloid, circuli moderate.

Dorsal spines low, rather slender, firm, fin entirely depressible in groove and its origin slightly behind that of pectoral. Soft dorsal with moderate anterior lobe which 3/5 in depressed fin. Finlets all about uniform. Anal begins opposite penultimate dorsal ray basally, lower, otherwise like soft dorsal. Caudal widely forked, lobes alike, slender, pointed. Pectoral moderate, extends 2/3 to soft dorsal origin. Ventral inserted slightly before pectoral origin, reaches 3 1/5 to anal. Vent close before anal.

Color when fresh deep neutral-dusky on back and upper surface, shading through neutral-gray on sides to pale gray on under surface of body. No sharp line of demarkation in color of back, though neutral gray of sides forms ragged margin along lower side of body. Each larger imbedded scale of body appears darker than surrounding membranes, thus producing finely and obscurely spotted appearance. Head largely neutral dusky, also iris. Fins all neutral dusky, at least lower ones terminally. Membrane of spinous dorsal black. Pectoral dusky, also dusky blotch at base, though not conspicuous and inside base jet-black.

The Museum has only the type, No. 3396, Bishop Museum, obtained in the market at Honolulu, December 28, 1922, by John W. Thompson, to whom I have dedicated the species. It is 965 mm. long and is related to *Nesogrammus piersoni* Evermann and Seale, from Sorsogon, Philippine Islands, known only from the type—an example but 16 inches long. *Nesogrammus thompsoni* differs in the presence of but a single developed lateral line. *Nesogrammus piersoni* is said to have two well developed lateral lines described with "the lower branch leaving the main lateral line under the base of third or fourth dorsal spine, from which point it extends nearly vertically downward to lower third of side, along which it runs, approximately parallel to the ventral line of body, to caudal peduncle." Further it is said to have "villiform teeth on vomer, palatines and tongue." The gill-rakers are described as "rather bluntly pointed, 15 on lower limb, the largest 3 in snout." The figure of *Nesogrammus piersoni* is shown with greatly higher spinous dorsal, shorter pectoral and ventral and more finlets than the Hawaiian fish.

ISTIOPHORIDAE

Istiophorus orientalis (Schlegel).

Tetrapturus mitsukurii Jordan and Snyder.

CARANGIDAE

Caranx kuhlii (Bleeker).

Caranx lugubris Poey.

Decapterus sanctae-helenae Valenciennes.

Scyris indica Rüppell.

BRAMIDAE

Taractes steindachneri (Döderlein).

PSENIDAE

Nomeus gronovii Gmelin.

Several from Laie.

Cubiceps thompsoni new species.

Head 3 1/2; depth 3 7/8; D. X-I, 14; A. II, 14; P. II, 19; V. I, 5; tubular scales 41 in lateral line, followed by 7 more non-tubular to caudal base, also with about 5 larger ones on latter 3 scales above lateral line to spinous dorsal origin, same to soft dorsal origin, 12 below to anal origin; 14 predorsal scales; head width 2 in its length; snout 3 1/10; eye 4 1/10; maxillary 4; interorbital 2 3/4; third dorsal spine 2 1/10; first branched dorsal ray (damaged) 4 1/3; first branched anal ray (damaged) 4 1/6; least depth of caudal peduncle 5; upper caudal lobe 1 1/6; pectoral 1 3/4; ventral 2 1/2.

Body elongately fusiform, well compressed, deepest at depressed tip of spinous dorsal or about midway in its length. Caudal peduncle well compressed, least depth 1 1/2 in its length.

Head well compressed, profiles convex with lower little more inclined, flattened sides slightly approximate below. Snout convex, with even swollen appearance, length 5/6 its width. Eye moderate, without adipose-lid, 1 1/4 in snout and hind pupil edge midway in head length. Mouth small with very short gape, closed mandible slightly protruding. Maxillary largely concealed, extends 3/5 in snout, expansion 2 3/4 in eye. Teeth minute, in narrow bands in jaws. No teeth on mouth roof or on broad depressed tongue, which rounded and free in front. Lips narrow, firm. Nostrils close together, each side of snout tip, front one simple pore and hind one vertical slit twice size of anterior. Preorbital width to maxillary groove, half of eye. Interorbital broadly and evenly convex. Preopercle edge entire.

Gill-opening forward opposite hind pupil edge. Gill-rakers 11 + 19, lanceolate, 2 1/5 in gill-filaments, which 1 2/5 in eye. Pseudobranchiae 1 1/2 in gill-filaments. Isthmus narrow, more slender forward, with right groove permitting gill-cover edge to fold within.

Scales thin, in even longitudinal rows, becoming smaller on back and belly medianly. Scales on head well covered over with adipose membrane. Soft dorsal and anal covered entirely with crowded and imbricated fine scales. Small scales on caudal base, also some small scales at pectoral base. Scales with 4 basal radiating striae, edge with 3 or 4 lobes and circuli very fine. Lateral line high, largely concurrent with dorsal profile, extends only to front of caudal peduncle above. Tubes well exposed, with many more or less fine parallel branches.

Spinous dorsal inserted about first fifth in pectoral, third spine longest, when depressed reaching beyond tips of last spines or 1 3/4 to soft dorsal. Latter inserted slightly nearer gill-opening than caudal base, with slight front lobe, rays all robust and connecting membranes rather low. Anal begins little behind soft dorsal origin, fin similar. Caudal strongly forked, long slender pointed lobes equal. Pectoral well inclined, reaches 2 1/5 to anal. Ventral origin slightly behind that of pectoral, reaches 1/3 to anal. Vent close before anal.

Color in alcohol pale olive-brown above, each scale edge with slaty tinge and lower surface of body but slightly paler. Head uniform brownish. Iris dull slaty. Spinous dorsal dusky, other fins more or less dull brown.

Type, No. 3403, Bishop Museum, 635 mm. long. Obtained by John W. Thompson in the market at Honolulu. It resembles *Cubiceps gracilis* (Lowe), from the Atlantic, but that species has fine scales.

SERRANIDAE

Epinephelus septemfasciatus (Thunberg).

Caesioperca thompsoni new species.

Head 3 1/2; depth 2 2/5; D. X, 16, 1; A. III, 7, 1; P. 11, 20; V. I, 5; scales 58 in lateral line to caudal base and several more non-tubular on latter; 7 scales above lateral line to spinous dorsal origin, 6 above to soft dorsal origin, 19 below to anal origin; 35 predorsal scales; head width 1 3/4 in its length; mandible 2; third dorsal spine 2 1/2; twelfth dorsal ray 1 1/4; third anal spine 2 7/8; least depth of caudal peduncle 1 7/8; pectoral 1; ventral 1 1/10; snout 4 2/5 in head measured from upper jaw tip; eye 4; maxillary 2 1/10; interorbital 3.

Body elongately ellipsoid, deepest near end of depressed pectoral, and predorsal compressed to keel. Caudal peduncle strongly compressed, length slightly less than its least depth.

Head small, well compressed, profiles alike, flattened sides slightly approximated below. Snout obtuse, convex, length 3/4 its width. Eye small, lateral, hind edge slightly before center in head length. Maxillary very oblique, reaches opposite front pupil edge and expansion 1 1/4 in eye.

Mandible strong, shallow forward, rami well elevated inside mouth. Teeth in jaws simple, conic, uniserial. Pair of strong upper canines and 2 each side, close together, flare out near symphysis of mandible, and together with upper canines visible when mouth closes. Upper jaw also with pair of approximated inner canines. Along each mandibular ramus anteriorly are strong curved canines. Small patch of small, simple, conic teeth on vomer and on each palatine. Apparently no teeth on ectopterygoids and none on tongue, which is free in front. Nostrils close before eye, front one a small simple pore with very slight cutaneous rim and hind one a short vertical slit close before eye. Interorbital convexly elevated. Hind preopercle edge and angle finely denticulated. No preopercular spine.

Gill-opening extends forward opposite front eye edge. Gill-rakers 11 + 27, lanceolate, slender, equal gill-filaments or 1 1/2 in eye. Pseudobranchiae 1 1/2 in gill-filaments. Isthmus narrowly constricted.

Each scale with auxiliary basal small one. Cheek with 12 rows of scales, exclusive of basal auxiliaries. Maxillary with 7 rows of scales across its expansion. Suprascapula entire. Small scales form restricted basal border to spinous dorsal, soft dorsal and anals, and extend over caudal base. Lateral line strongly arched, though its course is nearly concurrent with dorsal profile. Tubes all simple, anterior only half over each scale exposure and posterior entirely over scale exposure.

Dorsal spines slender, fin edge but slightly notched, first shortest and—after third and fourth, which are longest—nearly subequal. Soft dorsal more or less uniformly high to twelfth or thirteenth rays, which form little filament extending posteriorly nearly opposite middle of median caudal rays. Third anal spine longest, second sub-equal, and median soft rays form point extending opposite caudal base. Caudal elongate, strongly forked, with long slender lobes, each ending in filament and upper slightly longer, which 1 3/4 in rest of fish. Median pectoral rays longest, fin 1 1/4 to anal. Ventral not quite reaching vent or 4/5 to anal, spine 1 2/3 in fin.

Color in alcohol faded rosy-pink, now pale and more or less uniform. Fins yellowish.

Type, No. 3376, Bishop Museum, from Honolulu. Obtained February 11, 1922, by John W. Thompson. It is 200 mm. long. *Caesioperca* is represented previously only in the Austro-Pacific by *Caesioperca rasor* (Richardson) and *Caesioperca lepidoptera* (Schneider). Both differ from *Caesioperca thompsoni* in color and the presence of more fin rays.

Caprodon longimanus (Günther).

Odontanthias elizabethae new species.

Head 2 4/5; depth 2 1/3; D. X, 14, 1; A. III, 7, 1; P. 11, 16; V. I, 5; scales 37 in lateral line to caudal base and 3 more on latter; 8 scales above lateral line to spinous dorsal origin, 2 above to base of sixth dorsal spine, 16 below to origin of spinous anal; predorsal scales 38; head width 2 1/10 in its length; mandible 2; third dorsal spine 2 2/5; third anal spine 2 1/4; least depth of caudal peduncle 2 3/4; pectoral 1 1/6; ventral spine 1 7/8; snout 3 7/8 in head measured from upper jaw tip; eye 3 3/4; maxillary 2 1/10; interorbital 3 2/5.

Body elongately ovoid, deepest at hind edge of gill-opening and predorsal with scarcely developed median ridge. Caudal peduncle strongly compressed, length 3/4 its least depth.

Head moderate, well compressed, profiles alike, flattened sides evenly approximated above and below. Snout short, convex over surface, length 3/4 its width. Eye large, lateral, hind pupil edge about midway in head length. Maxillary very oblique, reaches front pupil edge, and expansion 1 3/5 in eye. Mandible strong, protrudes, rami well elevated inside mouth posteriorly. Teeth fine, in bands in jaws, broad patch on vomer, equally broad patch on each palatine and smaller patch behind on ectopterygoid. Pair of upper outer canines, inner upper pair closer. Two close-set lower canines flaring slightly outward, when jaw closes fitting close inside upper outer pair. Two strong curved canines anteriorly, close-set, on each ramus of mandible. Outer lower teeth, especially where extending along side of maxillary, slightly enlarged. Nostrils together, close before eye, anterior with rather short cutaneous edge, posterior larger pore close to upper front eye edge. Interorbital convexly elevated. Hind preopercle edge denticulate, few larger serrae along lower edge and broadly triangular preopercle spine about half length of pupil.

Gill-opening forward opposite hind nostril. Gill-rakers 14 + 30, lanceolate, slender, 1 1/3 in eye, and gill-filaments about 2/5 of longest gill-rakers. Pseudobranchiae slightly larger than gill-filaments. Isthmus narrowly constricted.

Sacles crowded on head above, and 12 rows across cheek. Maxillary with 8 rows of scales transversely. Suprascapula with about 5 denticles. Opercular spines 4. Bases of dorsals, anals and caudal finely scaly. Lateral line strongly arched, forms angle just before caudal peduncle, then straight to middle of caudal base. Tubes in lateral line simple, well-developed, each extending over scale exposure to its hind edge.

Color in alcohol faded dull brown, with ruddy tint. Broad white band encircles caudal peduncle, crosses lateral line at least 4 or 5 scales in width. Fins all pale.

Type, No. 3404, Bishop Museum, 217 mm. long, was obtained at Honolulu by John W. Thompson. It differs from the other species in the genus in its striking coloration. *Anthias rhodopeplus* Günther is figured with a yellowish streak from below the eye to the side of the breast, and another along the back embracing the caudal peduncle, but the latter with a purplish blotch above posteriorly. *Anthias chrysostictus* Günther is more closely allied in profile, but has the yellow band from the eye extending to pectoral base and body more uniform red. Named for my wife, Elizabeth K. Fowler, in slight tribute for her assistance during my work on Hawaiian fishes.

STEREOLEPOIDES new genus.

Type *Stereolepoides Thompsoni* new species

This nominal genus is established for the large Hawaiian jewfish, with a very narrow preorbital and therefore greatly diverse profile from *Stereolepis* Ayres. With the latter it is allied in the dentition, especially the absence of canines, the small eye, the head not rugose and the presence of a supplemental maxillary. (*Stereolepis,* the California jewfish, and **ειθας** appearance.)

Stereolepoides thompsoni new species.

Snout 4 in head, measured from upper jaw tip; eye 12; maxillary 1 1/2; interorbital 4 1/5. Maxillary width 1 3/4 in snout. Mandible strongly protrudes. Bands of fine simple conic teeth in jaws, in 8 to 10 irregular rows along side of lower jaw, which extend back well toward rictus. Bands of teeth in upper jaw little broader than lower bands. Patch of similar teeth on vomer and palatines. No canines. Nostrils close together and close before eye, similar in size. Hind preopercle edge finely serrate, with about 8 slightly enlarged denticles about angle. Three obscure opercular spines, all in about same vertical plane. Gill-rakers ix + xx, very short and tuberculate, greatly shorter than filaments. Scales on head cycloid, none on snout, maxillary, mandible or preorbital.

Type, No. 3406, Bishop Museum, a head 584 mm. long, from a large example obtained in Honolulu, by John W. Thompson. He estimates this fish between six and seven feet in length. He says its soft dorsal, anal and caudal were spotted with black.

PRIACANTHIDAE

Priacanthus boops (Schneider).

LUTJANIDAE

Aphareus thompsoni new species.

Head 3 1/8; depth 3 2/3; D. X, 11, 1; A. III, 8, 1; P. 11, 5; V. I, 5; scales 73 in lateral line to caudal base and 3 more on latter; 8 scales above lateral line to spinous dorsal origin, 17 below to spinous anal origin; 23

predorsal scales; head width 2 1/4 in its length; mandible 1 2/3; third dorsal spine 2 2/3; third dorsal ray 4 1/3; last dorsal ray 1 5/6; third anal spine 3 2/3; first anal ray 3 7/8; last anal ray 2; least depth of caudal peduncle 4 1/8; lower caudal lobe (tip broken) 1 1/5?; pectoral 1 1/10; ventral 1 1/2; snout 3 in head measured from upper jaw tip; eye 4 1/2; maxillary 1 7/8; interorbital 3 2/5.

Body elongately ovoid, strongly compressed, deepest at middle of depressed pectoral, slight median predorsal ridge, other edges convex. Caudal peduncle compressed, least depth 2 2/3 in its length.

Head attenuated, compressed, flattened sides approximating below, and profiles alike. Snout conic, width but slightly less than its length. Eye moderate, high, hind pupil edge midway in head length, 1 2/5 in snout. Mouth moderate, well inclined, gape straight. Mandible well protruded. Maxillary slips below rather narrow preorbital most its length, reaches opposite hind pupil edge and expansion 2 in eye. Bands of villiform teeth in jaws. Vomer, palatines and tongue toothless, latter depressed, free and rounded in front. Nostrils together, small, slightly before last fourth in head. Interorbital convex. Preopercle entire.

Gill-opening forward opposite first third in snout. Gill-rakers slender, lanceolate, 18 + 34, longest 1 1/10 in eye. Gill-filaments 1 2/3 in gill-rakers. Pseudobranchiae nearly long as gill-filaments. Isthmus narrowly compressed to long trenchant keel forward, with short pit or groove in front.

Scales in even longitudinal series, parallel with lateral line both above and below. Scales with 10 or 11 basal radiating striae and weak apical denticles 108 with about 15 transverse basal elements. Nine rows of scales across cheek to preopercle ridge. Muzzle, including maxillary, naked. Broad naked preopercle flange with fine radiating striae. Small scales on pectoral and ventral bases, more so on caudal base Lateral line largely concurrent with dorsal profile of back, simple tubes each extending about half of scale exposure.

Spinous dorsal origin close behind that of ventral, spines slender, third longest and fin edge entire. Soft dorsal origin about midway between caudal base and hind edge of gill-opening, rays gradually shorter to last, which extends back to caudal base. Spinous anal inserted opposite soft dorsal origin, third spine longest and soft fin like soft dorsal. Caudal strongly forked, slender lobes pointed (damaged), apparently equal. Pectoral long, slender, pointed, reaches back opposite vent, which 7/8 of eye-diameter before anal. Ventral inserted close behind pectoral base, fin reaches 1 2/3 to anal, spine 2 1/4 in head.

Color in alcohol faded uniform or dull brown, but slightly paler below. Iris pale slaty.

Type, No. 3397, Bishop Museum. Obtained by Mr. John W. Thompson in the market at Honolulu. It measures 451 mm. Representing a new species, distinguished by the greatly increased gill-rakers, nearly twice as many as in *Aphareus furcatus*. The long falcate pectorals and pale coloration are other characters of distinction. Compared with four examples of *Aphareus furcatus* I find that species to have the gill-rakers but II to V, 4 to 6 + 16 to 18.

MULLIDAE

Upeneus barberinus (Lacépède).

PSEUDOCHROMIDAE

Pseudochromis polyacanthus Bleeker.

LABRIDAE

Lepidaplois modestus (Garrett).
Coris variegata (Rüppell).
Julis greenovii Bennett.

CALLYODONTIDAE

Scaridea balia Jenkins.
Callyodon troscheli (Bleeker).
Callyodon xanthopleura (Bleeker).

HISTIOPTERIDAE

Histiopterus typus Schlegel.

One from Hilo.

CHAETODONTIDAE

Chaetodon collaris Bloch.

Hemitaurichthys polylepis (Bleeker).

Hemitaurichthys thompsoni new species.

Head 3 1/3; depth 1 3/4; D. XII, 26; A. III, 21; P. II, 17; V. I, 5; scales 81 close above and along lateral line to caudal base, and about 15 more out on latter; tubular scales in lateral line 79 to caudal base; 18 scales above lateral line to base of first dorsal spine, 7 above to base of first dorsal ray, 40 below to spinous anal origin; about 60 predorsal scales; head width 2 1/3 in its length; mandible 2; sixth dorsal spine 2 1/3; seventh dorsal ray 1 3/5; third anal spine 1 9/10; third anal ray 1 1/3; least depth of caudal peduncle 2 7/8; caudal (tips damaged) 1; pectoral 1; ventral 1; snout 2 2/3 in head measured from upper jaw tip; eye 3 1/4; maxillary 4 1/6; interorbital 3 1/3.

Body deeply ovoid, strongly compressed, greatest depth at tip of depressed ventral spine. Caudal peduncle small, well compressed, length 3/5 in its least depth.

Head strongly compressed, flattened sides moderately constricted below, upper profile well curved concavely to occiput, then slightly convex to spinous dorsal, and lower profile concave, though more inclined. Snout conic, compressed, width 1 2/5 in its length. Eye large, well elevated, center midway in head. Mouth small, terminal, jaws greatly protractile, though even when closed. Maxillary slips largely below preorbital, reaches half way in snout and expansion 3 1/4 in eye. Teeth fine, simple, conic, in narrow bands in each jaw. Nostrils close together, front one at last fourth in snout and hind one slightly elevated close along front edge. Both nostrils simple pores of moderate size. Interorbital convex. Preorbital width 1 2/5 in eye. Preopercle entire.

Gill-openings forward opposite front pupil edge. Gill-rakers 6+12, short weak points 1/6 of gill-filaments which 1 3/5 in eye. Pseudobranchiae long as gill-filaments. Isthmus narrowly constricted, rounded convexly over surface.

Scales finely ctenoid, above lateral line in even longitudinal series parallel with its course anteriorly, after arch horizontal or but little inclined upward. Scales below lateral line in even longitudinal series. Scales smaller along edges of body, largely over vertical fins and upper surface of head. From lower eye edge 9 rows of scales across cheek to preopercle keel and 4 more across preopercle flange. Head scaly except small area around nostrils, front of snout, muzzle and lower face of mandible. Scales with 7 or 8 basal radiating striae, apical denticles 47 to 52 and basal elements in 3 series, circuli moderate. Suprascapula ends in 6 small denticles. Lateral line arched, largely concurrent with dorsal profile, at least squamous area on dorsal fins, falls behind until level with upper third of caudal peduncle to caudal base. Tubes in lateral line small, simple, well exposed.

Spinous dorsal origin above gill-opening, spines graduated up to sixth, which longest, afterwards subequal (eighth and ninth abnormally short). Soft dorsal rounded, origin slightly nearer caudal base than pectoral origin, median rays longest. Spinous anal origin opposite base of eleventh dorsal spine, spines graduated to third, which longest. Soft anal like soft dorsal, rounded, though front rays little highest. Caudal broadly triangular, hind edge concave. Pectoral reaches opposite base of third anal spine, upper rays longest. Ventral origin opposite that of pectoral, fin reaching base of second anal ray, spine 1 4/5 in head. Vent half an eye-diameter before anal origin.

Color when fresh deep uniform neutral dusky, especially on outer portions of vertical fins. Ventrals largely blackish. Pectoral pale dusky. Sides of chest with deep bluish reflections. Jaws dusky. Iris blackish.

Type, No. 3390, Bishop Museum, secured November 12, 1922, by John W. Thompson in Honolulu. Length 168 mm. It is another interesting addition of the genus *Hemitaurichthys*, differing at once from the *Hemitaurichthys polylepis* in its uniform dark color, increased soft rays in both dorsal and anal, entire preopercle and much smaller scales.

Holacanthus arcuatus Gray.

Holacanthus flavissimus Cuvier.

ACANTHURIDAE

Hepatus nigricans (Linné).

Hepatus thompsoni new species.

Head 3 7/8; depth 2; D. IX, 24, 1; A. III, 24, 1; P. 11, 14; V. I, 5; scales about 142 counted along close above lateral line to caudal base; 16 scales above lateral line to soft dorsal origin, 60 below to spinous anal origin; head width 1 4/5 in its length; ninth dorsal spine 1 7/8; ninth dorsal ray 1 2/5; third anal spine 3 1/3; sixteenth anal ray 1 1/3; least depth of caudal peduncle 2 1/3; ventral 1 1/10; snout 2; eye 3 4/5; maxillary 4 1/3; interorbital 2 2/3; caudal 2 1/2 in combined head and trunk; pectoral 3 1/8.

Body strongly compressed, contour rather evenly ovoid, deepest at anal origin, predorsal trenchant and breast convexly rounded. Caudal peduncle strongly compressed, length 3/4 its least depth.

Head rather small, lower profile slightly more convex, flattened sides but slightly approximate below. Snout compressed, profile slightly convex, width 1 1/4 its length. Eye elevated, front pupil edge midway in head length, 1 2/3 in snout. Maxillary concealed by broad preorbital. Mouth with short gape, about 2/3 its width. Teeth compressed, uniserial, each edge moderately crenulated. Nostrils together, close before eye, front one pore with slight cutaneous rim about last fourth in snout length and hind one short horizontal slit midway between front one and eye. Interorbital convexly elevated, giving place to median trenchant keel extending to spinous dorsal. Preopercle edge entire, inclined forward until angle falls opposite front pupil edge. Preopercle flange, opercle and exposed shoulder,girdle with rather coarse striae.

Gill-opening forward opposite front eye edge. Gill-rakers 5 + 10 short points, about 1/5 of gill-filaments, which are as long as eye. Pseudobranchiae 3/4 of gill-filaments. Isthmus moderately constricted, produced into broadly convex lower edge, its width but slightly greater than eye.

Scales small, all closely and firmly adherent, finely ctenoid on trunk, cycloid on head. All fins covered with fine scales basally, less on pectorals than on others. Scales with 17 to 26 apical denticles, transversely about 9 series and circuli fine. Lateral line complete, tubes very distinct and pores very small.

Spinous dorsal origin opposite upper hind edge of gill-opening, spines firm, graduated up to last, which longest. Soft dorsal origin midway between front nostril and caudal base, last rays of fin ending in point. Origin of spinous anal midway between snout tip and base of last anal ray, spines graduated up to third which longest, though shorter than first ray. Soft anal like soft dorsal. Caudal widely lunate, ending in long slender points, upper slightly longer. Lance slender, long as eye. Pectoral with upper rays longest, pointed, reaches base of third anal ray. Ventral inserted close behind pectoral base, depressed fin reaching base of first anal ray and spine 1 2/3 in head, it reaching origin of spinous anal.

Color when fresh dark neutral dusky, uniform and all vertical fins more or less blackish. Pectoral with dusky olive tinge and within basal portion of its axil jet-black blotch, less than eye, extending slightly below lowest rays. No white or pale edge on any of the fins. Iris dusky. Lips black. Teeth white.

Type No. 3394, Bishop Museum, obtained at Honolulu, December 10, 1922, by John W. Thompson. Length 223 mm. Unique among Hawaiian tangs in its nearly uniform dark or blackish color, with a black blotch extending a little from below axil of pectoral fin. It closely suggests *Acanthurus mata* Valenciennes, as figured and described by Day from Madras. That fish does not have the black blotch extending from the axil of the pectoral below the base of the fin.

BALISTIDAE

Balistes fuscus Schneider.

Canthidermis maculatus (Bloch).

Canthidermis rotundatus (Proce).

OSTRACIIDAE

Ostracion cubicus Linné.

TETRODONTIDAE

Liosaccus cutaneus (Günther).

Canthigaster margaritatus (Rüppell).

MOLIDAE

Masturus lanceolatus (Liénard).

SCORPAENIDAE

Taenianotus triacanthus Lacépède.

Iracundus signifer Jordan and Evermann.

ECHENEIDIDAE

Remoropsis brachyptera (Lowe).

PLEURONECTIDAE

Platophrys thompsoni new species.

Head 3 1/2; depth 1 2/3; D. 86; A. 62; P. 11; V. 6; scales 132 counted close along lateral line to caudal base; tubes in lateral line 92 to caudal base and 3 more on latter; 34 scales above arch of lateral line to profile of back; 55 scales below, near beginning of lateral line, to ventral edge; width of head 3 2/5 in its length; height of dorsal at greatest body width 2 2/5; height of anal opposite middle in straight section of lateral line 2 1/3; least depth of caudal peduncle 2 3/5; caudal 1 1/6; pectoral 1 2/5; ventral length 1 3/5; snout 4 1/3; eye 3 1/4; maxillary 3; interorbital 1 7/8.

Contour of body deeply ovoid, deepest at beginning of straight section of lateral line. Caudal peduncle greatly restricted, strongly compressed.

Head very deep, upper profile steeply arched. Snout short, about 3/4 of eye. Eyes greatly separated, posterior beginning directly behind anterior, equal in size or half of interorbital. Mouth small, curved little from vertical downward with gape nearly reaching eye, jaws even. Maxillary narrow, expansion 3 1/4 in eye. Bands of moderate simple conic teeth along each jaw edge, upper extending along premaxillary to its hind end. Teeth of left side exposed when mouth closes, on right side concealed by rather narrow lips. Nostrils close together, each with rather low cutaneous border and both placed close before lower eye level with front of supraorbital ridge. Latter has several bony jagged points or irregular denticles at same point, depression separating it from upper front bony ridge of lower eye which has a similarly jagged edge. Bony jagged point near side of snout tip. Upper eye with antero-orbital bony keel and both anterior lower and superior upper with keel or ridge, these smoother. Interorbital concave, broadly depressed medianly. Preopercle edge entire.

Gill-opening extends forward about opposite hind pupil edge of lower eye. Gill-rakers v, I + II, III, lanceolate, half of gill-filaments, which 2 1/3 in eye. Pseudobranchiae long as gill-filaments. Isthmus long, slender, compressed keel or prow, extended under gill-covers opposite front edge of eye.

Scales very fine and uniform over most of body, ctenoid on cheeks and both postoculars on left side, besides about bases of dorsal and anal. Rest of left side with nearly smooth scales like all on right side, membranes of fin rays all finely scaled. Postorbital scales with 35 to 42 waved radiating striae, apical denticles 16 or 17 rather large and 1 or 2 auxiliary very short basal series. Body scales similar, without denticles. Lateral line with strong though rather short anterior arch, its length 5 2/5 in straight section. Tubes simple, large and well exposed.

Dorsal begins on snout 2/3 an eye-diameter from snout tip, front rays with only tips slightly free and other rays evenly connected. Front median dorsal rays longest. Anal begins little before pectoral origin and hind median rays longest. Caudal convexly rounded behind, median rays longest. Pectoral small, oblique, reaches about first fourth in lateral line. Ventral with broad base, 1 1/3 in interorbital.

Color in alcohol dull brown on left side, with grayish sepia tint, very finely mottled or marbled with brownish. Many dark brown specks, vermiculations and bars sprinkled about, these most distinct and definite, dark or dusky, along upper front keel of head and about front of each eye. On interorbital they gradually become fewer. Three clusters of dusky spots along straight section of lateral line. Vertical fins mottled with pale dusky spots, variable, though along dorsal and anal seven or more rather distinct dark spots along each fin sub-basally, each separated by 7 or 8 rays. Right side of body pale or uniform whitish, only terminal dark spots of vertical fins showing through as grayish or dusky-gray.

Type, No. 3398, Bishop Museum, 134 mm. Obtained by John W. Thompson at Honolulu. Among the Hawaiian species of *Platophrys* the present is most closely related to *Platophrys mancus* in its widespread eyes with a broad interorbital space. Upon comparison with a series of *Platophrys mancus* of similar size, the squamation is seen to be very similar, the fin rays much fewer in number, and the upper frontal profile so different, that the much wider interorbital renders the upper eye at an oblique angle in the opposite direction or sloping from left to right downward. I have seen no examples of *Platophrys mancus* with so few rays in the anal fin. On the contrary I have seen no example of *Platophrys mancus* with the largely cycloid sclaes of the left side nor are they ever so minute. In a Palmyra example at hand, all are ctenoid on the left side.

CALLIONYMIDAE

Calliurichthys decoratus Gilbert.

GOBIIDAE

Chlamydes laticeps Jenkins.

Laie, Oahu.

Gobiopterus farcimen Jordan and Evermann.

BLENNIIDAE

Cirripectes alboapicalis (Ogilby).

Salarias meleagris Valenciennes.

Mokuauia Island, Laie Bay, Oahu.

Enchelyurus edmondsoni new species.

Head 4; depth 4 5/6; D. 32; A. 20; P. 15; V. 2; head width 1 1/2 in its length; snout 4 1/8; eye 3 1/5; mouth width 4; first dorsal spine 2 2/5;

twentieth dorsal ray 1 1/3; tenth anal ray 2; least depth of caudal peduncle 3; caudal 1 1/4; pectoral 1 1/5; ventral slightly greater than head.

Body moderately long, deepest about middle of pectoral, well compressed. Caudal peduncle not free, well compressed.

Head moderate, surface convex, little swollen below to slightly constricted above. Snout very obtusely convex in front, length half its width. Eye large, hind edge at first 2/5 in head, its diameter twice snout in profile. Mouth broad, inferiorly transverse, gape not quite extending back opposite front edge of eye. Teeth fine, even, in single row in each jaw. Maxillary reaches back opposite front edge of pupil. Lips thin, even, entire. No orbital or nasal tentacles. Interorbital moderately convex, wide as eye.

Gill-opening vertical lateral slit, about equals eye. Skin entirely smooth. Lateral line not evident.

Dorsal origin over last fifth in length of head, flexible spines hardly distinguishable from soft rays, without notch and fin united broadly with caudal. Anal begins midway between front edge of eye and caudal base, edge of fin slightly notched on each membrane all along, united with caudal. Caudal with median rays longest, rounded behind. Pectoral broadly rounded, reaches 4/5 to vent. Ventral jugular, inner ray longer and reaches vent, which close before anal.

Color in alcohol dusky-brown, or general color uniform. Side of head with four or five dusky streaks inclined forward, below six more inclined backward. Black blotch at front of dorsal and rest of fin with many black lines, parallel and inclined up posteriorly. Caudal uniform. Anal with three longitudinal rather broad dusky bands its whole extent. Pectoral and ventral uniformly pale. Iris slaty.

No. 3401, Bishop Museum. Type. Honomuni, Molokai. July, 1914. W. A. Bryan. Length 34 mm.

Differs from *Enchelyurus ater* (Günther) in its variegated color-pattern. *Enchelyurus ater* is uniform blackish-brown. Named for Charles H. Edmondson in appreciation of his work on Hawaiian crustacea.

CARAPIDAE

Fierasfer homei (Richardson).

Jordanicus gracilis (Bleeker).
Kahola, Oahu.

TRICHONOTIDAE

CRYSTALLODYTES new genus.

Type *Crystallodytes cookei* new species.

Body greatly elongate, partly cylindrical. Head conic, attenuate. Snout produced, with broad premaxillaries. Eyes high, very small. Mouth inferior, with rather long gape. Lower teeth better developed than upper, and none on palate. Interorbital very narrow, shallow. No gill-rakers. Pseudobranchiae well developed. No scales. Lateral line complete, with well developed pores. Dorsal and anal without spines, rays all simple, flexible, begin well behind pectoral, free from caudal, in moderate number. Caudal rounded. Pectoral and ventral well developed. Coloration pellucid. (Κρ'σταλλος, crystal; δ'α, to dive.)

Minute fishes of tropical sandy shores. The genus differs from *Trichonotus* from the East Indies in the absence of teeth on the palate, the absence of scales and the protruding upper jaw, minute eyes and enlarged teeth of the lower jaw. With the exception of the protruding upper jaw it likewise differs from *Hemerocoetes* from New Zealand.

Crystallodytes cookei new species.

Head 5; depth 9; D. 36; A. 36; P. 10; V. 1, 5; head width 2 in its length (now abnormally expanded much wider); snout 3 3/4; orbital socket 6 1/2; maxillary 2; pectoral 1 3/4; ventral 2 1/8; least depth of caudal peduncle 4; caudal 1 7/8.

Body very slender, terete, subcylindrical anteriorly, becoming compressed posteriorly, deepest at pectoral origin and edges all evenly convex. Caudal peduncle slender, compressed, about long as deep.

Head pointed, conic, apparently normally deep as wide. Eye very small, about 1/3 of orbital socket, supra-lateral, directed largely forward, impinging on upper profile. Hind edge of orbital socket about half an eye-diameter before center in length of head. Maxillary slender, reaches half an orbital diameter beyond orbit. Minute teeth in row on maxillary and larger ones well spaced, in row along each mandibular ramus, also inner irregular row of very small low teeth. Premaxillaries anteriorly very broad, length not quite half of snout length. Interorbital little less than orbit, concave. Cranium rather evenly convex. Each nostril in short tube close to end of snout before premaxillary bases. Opercle with numerous or rather close-set radiating striae.

Gill-opening extends forward opposite hind orbital edge. Gill-filaments short, barely half of eye. Pseudobranchiae long as gill-filaments. Isthmus narrowly constricted, long, more slender forward and gill-membranes not united or forming fold across.

Body smooth, naked. Lateral lilne median from shoulder to caudal base, with 55 pores to latter.

Dorsal origin begins at first 2/5 in combined head and trunk length, fin uniformly high most its course, or 3/5 of body depth, and only last rays gradually shorter. Anal like dorsal, begins slightly behind base of second dorsal ray. Caudal moderate, median rays longest, hind edge rounded. Pectoral with upper rays longest, reaches 3/5 to dorsal. Ventral inserted immediately before pectoral base, depressed 2/5 to anal.

Color in life transparent or nearly glassy. Iris silvery. Back with eleven clusters of minute dusky dots or points, close-set and forming as many dorsal saddles. Traces of as many, though slightly paler, alternate narrower saddle-like bars, also down back in intervening areas, though these not so distinct or extending so far down on sides. Orbital socket dusky.

Type, No. 3400, Bishop Museum, 30 mm. long. Taken November 5, 1922, at Laie Beach, Oahu, by Charles Montague Cooke 3rd, to whom the species is dedicated. Found in the sand scooped up just below the edge of the tidal wash. In life it is exceedingly difficult to detect, moving easily through the moist sand with which it harmonizes to a remarkable degree. This effect is heightened by its transparent or pellucid body, the pigment cells on the back showing both as dusky points and little silvery areas.

GADIDAE

Physiculus kaupi Poey.

LOPHOTIDAE

Lophotes capellei Schlegel.
Laysan Island.

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